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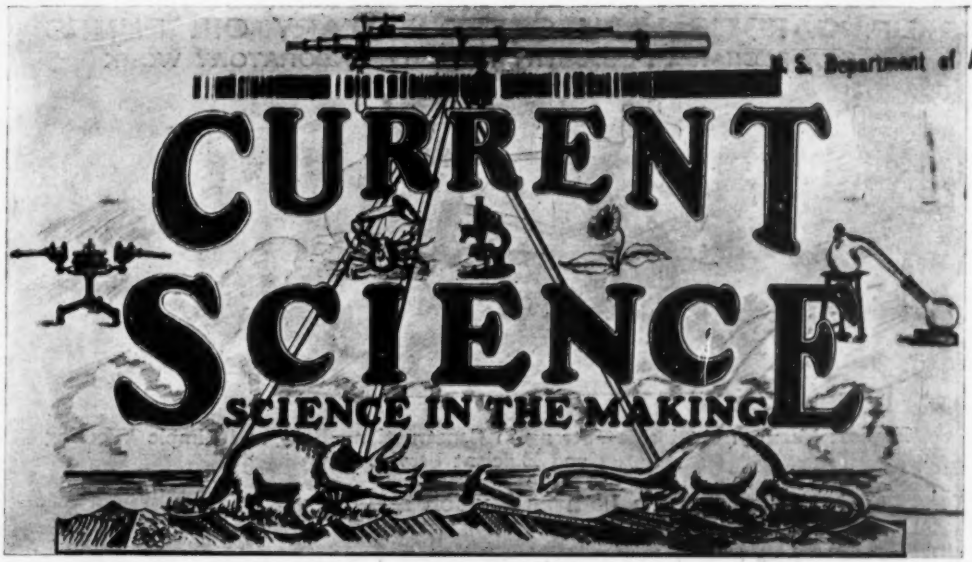

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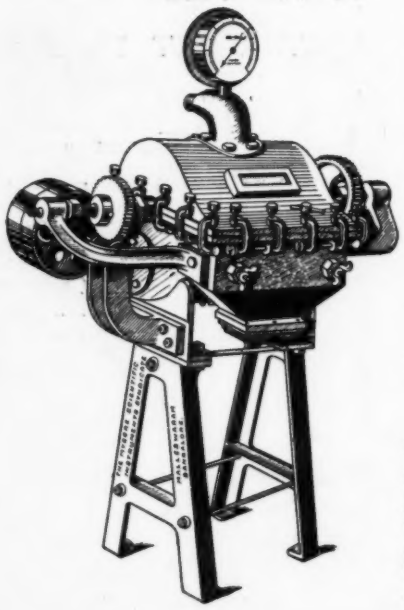

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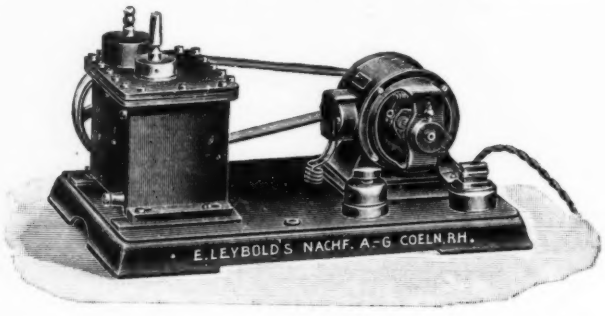

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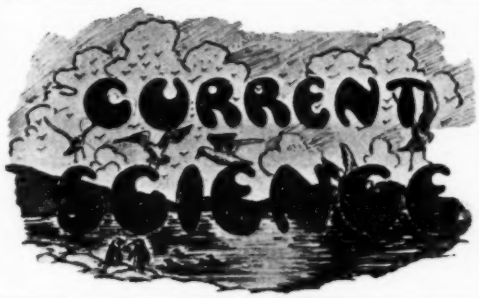

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From Pusa to . . . ?

THE disastrous earthquake of last January brought with it a chain of problems not the least important of which is the future location of the Imperial Institute of Agricultural Research now situated at Pusa in Bihar. The buildings of the Institute were badly damaged by the earthquake, so, on the recommendation of their experts, the Government decided to abandon them and construct new ones in the neighbourhood of Delhi. This decision, which would involve far heavier expenditure than repair to the old buildings, has now met with considerable opposition. The controversy has indeed assumed such serious proportions that not a day passes without some communication to the press–an important interview, resolution passed at a public meeting or proceedings of a lively discussion at a council of legislatures. Although the social, the economical and the political aspects of the question are now being hotly debated, yet very little is heard regarding the technical considerations which prompted such a decision. In fact, the scientific opinion of the country has hardly expressed itself on this highly important question. It is our present object, therefore, to view the position mainly from the scientific standpoint and to consider the possible influence of the proposed transfer on the progress of agricultural science in the country.

It is argued by those in favour of the transfer that Pusa being in the heart of a region frequently subject to earthquakes, more shocks might follow in the future and the entire building might soon collapse causing considerable loss of life and property. This danger can be eliminated by transferring the Institute to Delhi. Furthermore, the transfer will remove certain disabilities from which the Institute suffered in the past. The soil conditions in the neighbourhood of Delhi will be more representative of the Indo-Gangetic plain than the naturally rich tracts of Pusa. The Institute will also be more accessible and bring the officers into better contact with legislators, agriculturists, industrialists and others visiting Delhi from time to time.

Among those who are opposed to the transfer, (1) a large number are definitely in favour of retaining the Institute at Pusa itself after strengthening the buildings in such a manner as to withstand future

shocks; (2) some are for distributing the activities between different centres; and (3) others are for shifting the Institute to the neighbourhood of a centre of scientific learning like Allahabad, Bangalore, Bombay or Calcutta. The first group of opponents point out that, in recent years, a number of building materials have been discovered which can withstand earthquake shocks. Such materials can be used for repairing and reinforcing the buildings at Pusa. They also hold that Pusa has always been accessible to those who are interested and that the soil conditions at Pusa are not greatly different from those prevalent elsewhere. The second group argue that India is a vast agricultural country with varying soil and climatic conditions, so that no single institute situated anywhere can adequately meet the needs of the whole country. They plead therefore for a number of research institutions distributed throughout the country. The last group agree that Pusa is not suitable but point out that Delhi is also unsuitable. The scientific workers require isolation and peace rather than the crowded and disturbed atmosphere of a political centre. They favour, therefore, the transference of the Institute to the proximity of a centre of learning where a scientific atmosphere would prevail, where there is likely to be the least disturbance at work and minimum interference from those in power. There is something to be said for each point of view, so all the facts should be taken into consideration before arriving at a decision.

Before taking up a discussion of the various technical points at issue, it would be of some assistance if we could define, in a general way, the objects of the Institute, and the type of facilities that are required for carrying them out. It is true that for a long time, the Pusa Institute, with its various sections and sub-sections distributed in the different provinces of the country, was the only centre of agricultural research. Problems of not only All-India character but also those of provincial interest had therefore to be investigated by the Institute. Post-graduate training in agricultural science had to be imparted and the staff of the newly created provincial agricultural departments trained in methods of research. Today, the conditions have greatly altered. Most of the provincial departments have been adequately organised and are in charge of competent men who could deal with all the local problems. Many of the Universities, as also research institutes, have organised post-graduate training in different branches of agricultural science so that the need for special courses of the type that was in vogue in the past has also greatly disappeared. Even problems of all-India character which the provincial departments cannot adequately handle are fast diminishing, so the Institute is now largely free to devote itself to problems of fundamental interest. In view of the importance of this type of work and the misconception that generally prevails regarding the utility of fundamental research, we wish to deal with it at some length.

The history of the development of scientific agriculture, as also any other branch of applied science, shows that the most important discoveries are made not by those working on fields or in factories but by pure scientists who plod in the seclusion of laboratories and pot-culture houses for the mere sake of small additions to knowledge. Those engaged on field work or factory operations are largely concerned with the immediate problems of their work and cannot find either the leisure or the opportunity to think out new ideas and to investigate their possibilities. On the other hand, the pure scientist has very few such worries and has often the freedom to think boldly and the facility to work out his ideas irrespective of cost or considerations of immediate return. Most of his researches may be of purely academic interest, but a single accidental finding with a new idea for its background may lead to the most far-reaching developments and thus make up thousand-fold for all the failures in the past. Such is the value and significance of fundamental research conducted by right men in the right environment; such is the right spirit in which agricultural research is being carried out at Rothamsted and other leading experimental stations of the World; and such should be the ideal before those in charge of the destinies of the Imperial Institute of Agricultural Research. Administrative routine and commercial enterprises should be reduced to the minimum and the research workers given ample freedom and facilities to devote themselves to fundamental research.

Let us now proceed to critically examine the various suggestions that have been made and to determine how far they would help towards the attainment of the ideal before

us. Taking first the suggestion that a number of research institutes should be created, we should agree that it would be quite useful to have them, though not for the purpose intended by some of the proposers. There is ample scope for several lines of fundamantal research but there is no need to duplicate the advisory work now conducted by the provincial agricultural departments. As for the proposed distribution of work between different provincial centres, it is highly undesirable. The different sections should be together at one place so that the workers may have opportunities for meeting each other and discussing problems of common interest.

Assuming that, at least for some time to come, there will be only one Imperial Institute of Agricultural Research, we shall next consider the type of facilities required for conducting fundamental work of a high order. Firstly, the Institute should be situated in a healthy locality which enjoys a salubrious climate. From this point of view there is not much to choose between Pusa and Delhi. Both the places are as good or as bad as most other places on the Indo-Gangetic plain. If a better climate is sought, the claims of Dehra Dun, Poona or Bangalore will come for consideration. Secondly, the buildings should be safe and there should be no fear of danger to life and property. An unsound building in an area susceptible to frequent earthquake shocks has an adverse effect on the morale of the workers though there may be no real danger for several decades to come. Before condemning the present buildings at Pusa, however, every effort should be made to strengthen them. Reinforced concrete is suggested as a suitable material for safeguarding the buildings against future shocks and it is for the experts concerned to conduct some rigorous tests with that and other materials before pronouncing the buildings to be beyond the stage of repair. Thirdly, there should be ample laboratory and library facilities. These are now being liberally provided by the Imperial Institute and will continue to be available irrespective of location. Fourthly, there should be a proper scientific atmosphere both in and around the place. This is of the greatest importance if work of high order is to be turned out. The scientific atmosphere of a place is partly due to tradition and partly to the example of some of the senior workers. Even a small band of enthusiasts with proper scientific outlook can infuse new spirit into a place and impart new traditions. Equally important is the scientific atmosphere around a place. There should be in the neighbourhood a number of research institutions devoted to other branches of science so that specialists in different fields will have opportunities to meet each other and discuss problems of common interest. Contact with workers in other fields widens one's outlook and facilitates better understanding of scientific problems. It infuses a spirit of comradeship and leads on to co-operative undertakings in which specialists in different lines join together in the investigation of problems of common interest. It even promotes a spirit of healthy rivalry which is highly desirable and helps to draw the best out of the workers. It is indeed this apparently vague, but nevertheless real, scientific atmosphere which is the secret of the success of most of the leading scientific institutions of the World. Judged from this point of view, both Pusa and Delhi will stand condemned. Pusa itself is isolated and the nearest centre of learning is Patna, a good distance away, on the other side of the river. Calcutta is still farther away and a long and expensive journey has to be undertaken to reach it. Benares and Lucknow are also a long way off. Coming to Delhi, it is undoubtedly a great political centre. Members of legislature and other leading citizens of the country visit the place from time to time. Meetings of the Advisory Board and the scientific committees of the Imperial Council of Agricultural Research are also being held there at least once a year. In spite of these associations, Delhi has yet to build up a scientific atmosphere. The Colleges in Delhi have, unfortunately, very few facilities for scientific research, so naturally much should not be expected from the University. Among the other centres of learning, Agra is some distance away; Lahore and Allahabad are farther still so that Delhi may also be regarded as isolated from the scientific point of view. If a transfer is decided on and if the value of proper scientific environment is taken into consideration, the Institute should be removed not to Delhi but to the neighbourhood of Allahabad, Bangalore, Bombay, Calcutta, or Lahore any one of which would be found more suitable.

In a vast country like India, no single place can be regarded as being easily accessible from all the provinces. If Delhi is easily accessible from the Punjab, Bombay, Central

India and certain parts of the United Provinces, Pusa may claim to be accessible to Bihar and Orissa, Bengal, Assam, parts of Central Provinces and a large section of the United Provinces. Both the centres may, on the other hand, be regarded as being inaccessible to Madras, Mysore, Hyderabad and South India in general. Thus, the charge of being inaccessible may be levelled against any place in India so that it is not quite fair to condemn Pusa mainly on that account. The things that really matter are good facilities, right talent and proper scientific atmosphere : if these are ensured, an institute situated even in the most obscure corner of the country can come to the forefront, and attract visitors not only from the whole of India but other parts of the World as well.

V. S.

The Malarial Parasites of the Oriental Monkey, *Silenus irus.**

By Lt. Col. J. A. Sinton, I.M.S.
(*Malaria Survey of India.*)

ONE cannot fail to be struck, in any study of the literature on malaria, by the paucity of the experimental evidence in support of many of the theories put forward. This is mainly due to the fact that all attempts to infect any of the common laboratory animals with the Plasmodia of human malaria have proved unsuccessful. Although much information has been gathered from the researches into avian malaria, there are many disadvantages and limitations in this work. Moreover, it is sometimes difficult to say exactly to what extent the results obtained are applicable to the human problem.

The discovery of the value of malarial infection in the therapy of certain nervous disorders, has opened up a wide field for gathering invaluable experimental evidence. Even under these more satisfactory conditions, the fact that human infections cannot be allowed to run their natural course, in many instances, restricts the usefulness of this line of investigation.

The monkey is the only one of the mammals commonly used for experimental work, in which the presence of natural malarial infection has been confirmed. The fact that such infections occur in a Primate host, suggests that the investigation and study of these conditions would give results more comparable with human infections than could be obtained with the avian type of disease. That malaria in monkeys might provide very valuable material to the malariologist, has long been borne in mind by workers in India.

Very many attempts made by them to discover such infections in the common brown monkey of northern India [*Silenus rhesus* (*Macacus rhesus; Macaca mulatta*)] have proved unsuccessful. This fact has often been deplored, but more recent evidence would appear to indicate that the absence of natural infection in this species of monkey is a fortunate occurrence, from the point of view of the research worker in India. The absence of such natural malarial infections in *S. rhesus* makes available large numbers of uninfected and susceptible Primates for experimentation. Workers on simian malaria in other countries have been greatly hampered in their investigations by the lack of such types of animal.

Malarial infections of monkeys were first recorded by Koch in East Africa in 1898. Since then many species of *Plasmodium* have been reported from various monkeys in different parts of both the Old and New Worlds. Many of the earlier investigators carried out experimental work with such infections. More recently, extensive researches have been reported by workers in America, Malaya and India. The latter work has confirmed the view that from a study of monkey malaria the solutions of many unsolved problems in human malariology may be obtained.

Research in human malaria has shown that the clinical and pathological manifestations of this disease, as well as its reaction to different therapeutic agents, vary with the species of *Plasmodium* responsible for the infection. It is, therefore, essential that an accurate specific identification should be made of the parasite used in any investigation. It is equally important to ensure that the infection studied is due to one species of *Plasmodium*, and one species only. A failure to obtain these conditions has been responsible for many of the con-

* Sinton, J. A., and Mulligan, H. W., *Rec. Mal. Survey India*, 1932, 1933 A, **3**, 357–414; 1933 B, **3**, 719–808.

tradictory statements which have crept into the literature on monkey malaria.

The older literature on the morphology of the Plasmodia of the lower monkeys was in a chaotic condition. This was partly due to the meagre descriptions given by some of the earlier workers of the parasites observed by them. It appears also to have been influenced largely by the fact that mixed infections with two or more species of *Plasmodium* are not rare in these animals, at least among the Oriental *Cercopithecidæ*. Many of the descriptions recorded appear to refer to two different species of parasite, which were present in the same host, but this condition was neither recognised nor suspected.

Sinton and Mulligan have carefully reviewed the literature on the Plasmodia of the lower monkeys. These workers made a special study of the malarial parasites found in the blood of the Oriental monkey, *S. irus* (*Macacus cynomolgus*; *Pithecus fascicularis*), the crab-eating monkey of Malaya and Burma. Individuals of this species of monkey are not uncommonly infected with malaria, but unfortunately these infections are not infrequently due to two or more species of parasite. The fact that such mixed infections were unsuspected, has given rise to much confusion in the descriptions of the Plasmodia infecting this species of monkey.

The first malarial parasite to be described from the lower Oriental monkeys was *Plasmodium inui* Halberstadter and Prowazek, 1907, from the blood of specimens of *S. irus* from Java and of *S. nemistrinus* from Sumatra. A few months later a new species *P. cynomolgi* Mayer, 1907, was recorded from an infection in *S. irus*, also from Java. Many observers consider that the latter species is identical with the former. Sinton and Mulligan, however, thought that *P. cynomolgi* was probably a distinct species, but placed it provisionally as a variety of *P. inui*. The reason for this was that, while they had had ample opportunity of studying *P. cynomolgi*, both in natural and in experimental infections, yet they had to depend for information about *P. inui* on descriptions given by other workers. As will be seen later, their views as to the specific identity of *P. cynomolgi* have since been confirmed.

Sinton and Mulligan proved that mixed plasmodial infections were not uncommon in *S. irus* in nature, and they managed to separate from the blood of this monkey two distinct species of *Plasmodium*. These parasites they identified as *P. inui* var. *Cynomolgi* Mayer, 1907, and a new species, *P. knowlesi* Sinton and Mulligan, 1932.

Plasmodium knowlesi does not appear to be very closely related to any of the three common malarial parasites of man, although it shows some morphological characters resembling each of these. This species was proved to have an asexual cycle of 24 hours' duration. While infection with this parasite has apparently little clinical effect on its natural host, *S. irus*, it produces quite a different picture when a susceptible host, such as *S. rhesus*, is infected experimentally with it. In the latter species of monkey, it causes very severe symptoms, often hæmoglobinuria, and almost invariably produces death with pernicious symptoms, if the infection be untreated. Knowles and Das Gupta have managed to transmit this infection to man by blood inoculation.

Plasmodium cynomolgi very closely resembles in its morphology *P. vivax*, the benign tertian parasite of man. It has a 48-hour asexual cycle. The clinical symptoms produced in *S. irus* and in *S rhesus* are of a mild character. This infection has been transmitted experimentally from monkey to monkey by the bites of infected specimens of *Anopheles annularis* and *A. subpictus*.

Since Sinton and Mulligan recorded these two species of *Plasmodium* from *S. irus*, a third species has been detected in their laboratories from the same species of natural host. The infection was also a mixed one originally, but a pure infection has now been isolated experimentally in *S. rhesus*. This parasite appears to be identical with *P. inui* sens. restr., as described by Halberstadter and Prowazek and by Mathis and Leger.

The morphology of this parasite has several points of resemblance to *P. malariæ*, the quartan parasite of man, but some forms more closely resemble *P. vivax*. The infection produces mild effects in *S. irus* and in *S. rhesus* and tends to be very chronic. The duration of the asexual cycle of *P. inui* sens. restr. was usually said to be 48 hours, but the evidence in support of this statement was very unsatisfactory. A careful study of long series of blood films taken every few hours from monkeys infected with this third parasite, shows that its asexual cycle has a periodicity of 72 hours.

These findings prove definitely that three species of *Plasmodium* occur naturally in the blood of the Oriental monkey, *S. irus* from Malaya, namely:—

(*a*) *P. knowlesi* Sinton and Mulligan, 1932, having a 24-hour asexual cycle;

(*b*) *P. cynomolgi* Mayer, 1907, having a 48-hour asexual cycle; and

(*c*) *P. inui* Halberstadter and Prowazek, 1907, having a 72-hour asexual cycle.

All these species are easily transmissible by blood inoculation to *S. rhesus*, and pure infections are being maintained in the laboratories of the Malaria Survey of India, Kasauli.

The facts (*a*) that the common brown monkey of Northern India (*S. rhesus*) is susceptible to experimental infection with these three species of simian Plasmodia, (*b*) that these monkeys appear to have no malarial infection in nature, and (*c*) that they are easily and cheaply available in India, open up a wide field in this country for the investigation of many important malaria problems. Such facilities are available in few or no other countries of the world.

Permeability of Protoplasm—A Probable Factor in Transpiration.

(Being a Study of Transpiration Response under Ultra-Violet Radiation.)

By B. N. Singh, D.Sc., and S. C. Das Gupta, B.Sc.

(Institute of Agricultural Research, Benares Hindu University.)

OF the various factors that appear to control transpiration it is the atmospheric ones which have received by far the greatest attention and much stress has been laid to show that transpiration is a relatively simple process, probably the simplest of all the plant functions yet known, governed largely by the environic complex. The behaviour of transpirational loss of water under controlled environment, however, has led Plant Ecologists to believe that there exist some internal factor or factors in transpiration, the nature of which does not seem to be well understood.

The present brief note is an outcome of some observations on the influence of ultra-violet radiation upon transpiration, and when taken in conjunction with an independent parallel study on permeability in plant tissues, seems to provide repeated conclusions of an uncommon interest, revealing that protoplasmic permeability performs a regulatory function in transpiration.

While investigations relating to the influence of ultra-violet radiation are known to exist, in an incomplete form though, upon such individual functions as photosynthesis, respiration and permeability in plants, to our knowledge, no observations appear to have been made so far as to the influence of such rays upon transpiration. The observations herein recorded are an attempt in this direction.

The procedure of experimentation in brief consists in selecting healthy mature cut twigs of *Cajanus indicus*, *Triticum vulgaris* and *Andropogan sorghum*, fixing them in hermetically sealed glass vessels containing sufficient water in which the cut end always dips, and estimating the hourly loss of water after the method already described elsewhere.[1] The experimental material is subjected to desired doses of 0, 5, 10, 15, 20, 30 and 40 minutes exposure to ultra-violet radiation.

On plotting the mean transpiration values for the treated plants obtained for a period of five successive hours against time (Fig. 1) it is noticed that the general nature of the response in all the three cases under consideration is similar in spite of material differences. We shall, therefore, try to explain the phenomenon on the basis of the data obtained for any one crop.

A reference to Fig. 2 would indicate that transpiration of irradiated plants exhibits two maxima, one under ten minutes treatment while the other under thirty minutes exposure. Both these pitches are preceded and followed by a decline in the transpiration curve which, in general, shows an unusual contrast to the curves of transpiration obtained for the control plants.

The increase or decrease in the rate of transpiration of treated plants as against the control, may be explained on the basis of certain imminent possibilities:—

(i) Variation in the supply of water from the roots.

[1] Singh, B. N., "On the Use of Bates Evaporimeter and Evaporimeters in general in Studies on Plant Transpiration," *Journ. Ind. Bot. Soc.*, 1924.

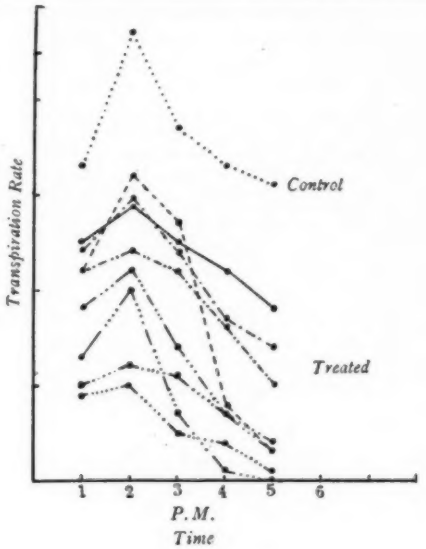

Fig. 1.

Showing Transpiration Rate of Cut Shoots of *Cajanus Indicus* with March of Time.

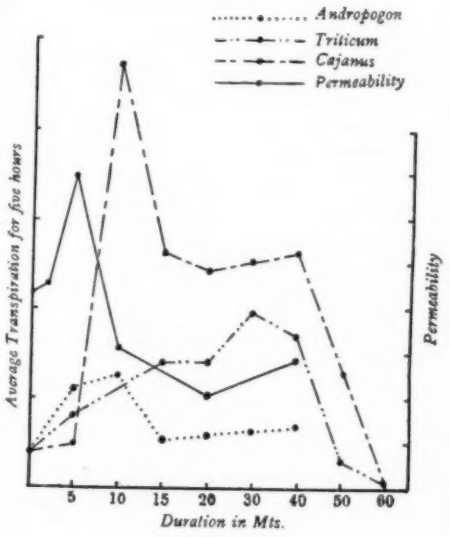

Fig. 2.

Showing Transpiration Rates and Permeability in Plants.

(ii) Variation in the stomatal aperture.

(iii) Changes in the leaf water-content.

The question of a deficiency of water supply should not ordinarily arise as in order to eliminate the root factor, experiments are conducted on cut shoots, with the cut ends dipping under water where a constant supply of the same is always available well above the requirements of the shoots. The experiments being conducted under moderate environmental conditions, the absorption from the roots is not expected to fall short of the demand of water made by the transpiring leaves.

For ascertaining how far transpiration is affected by the degree of stomatal opening in plants treated with varying doses of irradiation, comparative values of the average stomatal area and transpiration rate are obtained and portrayed below :—

Irradiation period in minutes	Tn. rate relative to tn. in control	Average area of stomatal opening size × 750
0	1·00	0·28
5	1·04	0·28
10	2·75	0·28
15	1·90	0·26
20	1·82	0·26
30	1·90	0·41
40	0·87	0·28

A glance at the values indicates that there exists no proportionality between the degree of stomatal opening and transpiration. The stomatal area remains unchanged for control and 5, 10 and 40 min. irradiation and shows small closing in case of 15 min. exposure and a marked opening at 30 min. Thus against both the maximum and minimum transpiration values for 10 and 40 minutes treatment respectively, the stomatal aperture remains unchanged. The maximum and minimum stomatal aperture also signifies no correlation whatsoever with the corresponding values of transpiration. Repeated observations as to the relation between stomatal opening and transpiration go to confirm the above conclusion, a fact further supported by the detailed work of Loftfield[2] on stomatal regulation where he has shown that widely open stomata, as is found in the present case, possess no control over the amount of water loss. In a more detailed study Singh and Sudame[3] have

[2] Loftfield, J. W. G., "The Behaviour of Stomata," *Carn. Inst. Wash. Pub.*, 314.

[3] Singh, B. N., and Sudame, M. M., "Size of Stomatal Chamber and Pore Diameter and their Role in the Regulation of Transpiration," (*In course of publication.*)

shown that the size of the stomatal chamber and the pore diameter seem to possess little control over transpiration, thus emphasising the view put forth above.

Barring the influence of stomata and deficiency in water supply, the explanation for an increase in the rate of transpiration must be sought elsewhere. As to the regulatory influence of leaf water-content, in a recent study Singh and Singh[4] have shown that the rate of transpiration is more or less independent of the leaf water-content and is to a large extent governed by absorption of water. But in the present experiments, as has already been indicated, limitations due to absorption did not arise.

How are we, then, to account for the variation in the transpiration rate? In this connection attention may be drawn to a separate work from this Institute upon the effect of ultra-violet radiation on the permeability of protoplasm[5,6] where an initial increase with increasing dose constitutes the first maximum followed by a second one after an intervening period of decline (Fig. 2).

The general similarity in the nature of the curves for permeability and transpiration following irradiation is indeed most characteristic and leads one to the conclusion that in the absence of the operation of the other controlling factors discussed above, increased or decreased transpiration may well be explained on the basis of permeability changes in the protoplasm of mesophyll cells.

The Study of Plant Tissue Fluids. A Critical Review.*

By B. N. Sastri and M. Sreenivasaya.
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PRESERVATION OF TISSUE FLUIDS.

THE tissue fluids thus obtained cannot be preserved even at low temperatures (0°C) without appreciable changes occurring in the fluid, the most prominent change being the precipitation of proteins through gradual coagulation. Gooke[38] has shown that, in the case of tissues, low temperatures induce an intramolecular change in the tissue proteins which leads to their denaturation; this circumstance has been correlated with winter-hardiness in plants. The coagulum adsorbs many essential constituents, particularly enzymes and viruses. Duggar[39] has found that the mosaic of tomato is not seed borne and opines that the seed proteins adsorb the virus. The failure to transmit many of the viruses through artificial injection of sap, as in the case of the spike-disease of sandal, is probably due to the circumstance that the virus gets adsorbed by the associated proteins during the preparation of the sap. In such cases, it is necessary to carry out the extraction with various buffers and the one which elutes the essential constituent chosen.

A similar procedure should be adopted for the study of enzymes on account of their analogous behaviour. The protein coagulation is influenced by tannins which in the case of certain enzymes like diastases are known to exert an inhibiting or inactivating influence. The effect of tannins and allied substances on the virulence of plant viruses has not been investigated. The extraction of sap from tannin-bearing tissues for certain enzyme studies, is best accomplished by adding hide powder during mincing and grinding. In their studies on the diastatic activity of the diseased and healthy sandal leaves, the authors have adopted this procedure. For the investigation of special constituents, certain modifications in technique have therefore to be introduced, and it is difficult to recommend any one general procedure for universal adoption.

For a study of the infectivity of viruliferous tissue fluids or for determining the resistance offered by tissue fluids to the growth of certain pathogens, the fluid should be obtained under aseptic conditions as it does not permit of heat sterilization.

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[4] Singh, B. N., and Singh, R. B., "The Relative Efficiency of Leaf Water-Content and Absorption in Transpiration." (*In course of publication.*)

* Continued from *Curr. Sci.*, 1934, **3**, 8.

[38] Gooke, *C. A.*, 1907, **1**, 196.

[39] Duggar, *J. Bact.*, 1930, **19**, 20.

[5] Singh, B. N., and Chakravarty, S. C., "Effect of Ultra-violet Rays on the Permeability of Protoplasm of *Trapa bispinosa* to Ions." (*In course of publication.*)

[6] Singh, B. N., and Sheshagiri, P. V. V., "Effect of Ultra-violet Rays on the Permeability of Protoplasm of Storage Tissues to Ions." (*In course of publication.*)

A convenient method for obtaining sterile fluids has been described by Ranker.[40]

METHODS OF INVESTIGATION AND THEIR CHOICE.

Tissue fluid studies may be classified into three broad divisions: (1) Physico-chemical; (2) Chemical, and (3) Biochemical. Physico-chemical methods include determinations of density, refractive index, depression of freezing point, electrical conductivity, hydrogen-ion-concentration, buffer values, optical activity, oxidation-reduction potential, temperature of coagulation, etc. Chemical methods are employed for an estimation of total solids, ash and ash constituents, total and amino nitrogens, carbohydrates and sugar alcohols, volatile and gaseous constituents like hydrogen cyanide, aldehydes and carbon dioxide, chlorophyll and other pigments, glycosides, alkaloids, tannins, fats and lipoids. Biochemical and biological methods are invoked for a study of the enzyme make-up of a fluid or a determination of the infectivity of a virus-bearing sap, or for an estimation of certain constituents like sucrose, maltose, inulin, glycosides, which are attacked by specific enzymes.

The choice and adoption of a particular method depends upon the nature of the problem, the accuracy required and the rapidity and frequency with which the samples have to be analysed. Generally, for the investigation of a given problem, one is rarely called upon to estimate all the constituents or conduct all physico-chemical measurements.

Physico-chemical methods are, in general, more elegant, less cumbersome, possess greater ease of reproducibility, require smaller quantities of samples and are conducted with greater rapidity and accuracy. In many of the measurements like the determination of the depression of the freezing point and electrical conductivity, the chemical composition of the tissue fluid is not affected, and the same aliquot of the fluid usually suffices for a few of the other determinations, thus effecting great economy in the use of research material. Wherever possible physico-chemical methods should be preferred to chemical methods.

Chemical methods, indispensable for the determination of certain constituents, require appreciable amounts of tissue fluid for analysis. The quantity required depends upon the concentration of the constituent in question and the sensitiveness of the method employed for its determination. Micro methods, if adopted, economise the material, and their application to the study of tissue fluids offers a wide and fruitful line of research. Animal physiologists have attained great distinction in this line, many of whose methods can be adopted in these studies.

Biochemical methods are characterised by the great specificity of their reactions which render the estimation of certain constituents infallible, and in certain cases they are the only methods available. An estimation of a glucoside, maltose and sucrose in a mixture, for example, is best accomplished with the aid of suitable enzyme reagents free from interfering enzymes.

PHYSICO-CHEMICAL MEASUREMENTS AND THEIR SIGNIFICANCE.

A. *Density.*—Density, determined pyknometrically, has been found useful in evaluating the solid content of the tissue fluids of a plant at various phases of its growth. The measurement does not influence the composition of the fluid in any manner and requires 5—10 c.c. of the fluid.

Density measurements have revealed that rapid growth is accompanied by lower concentrations while a dormant condition induces higher concentration of solutes in sap;[37,41,42] so does production of fruit.[43] Density is influenced by soil moisture[44,45] and by other factors of habitat of the plant.[41,45] Aquatic plants generally have a sap of low density. An idea of the water requirement of a crop or plant can be obtained by a determination of the density of its tissue fluids; the density is inversely proportional to their water requirements.[44] No relationship seems to have been observed between winter hardiness and density.[9,12] Determinations of density form a routine procedure in the chemical control of certain industries such as sugar, fruit syrups, etc.

Sap concentration is affected by the onset of diseases. Corn stalks affected by smut,[46] tissues from spiked sandal plants,[47] and

[40] Ranker, *Phytopathology*, 1930, **20**, 569.

[41] Reed, *J. Agr. Res.*, 1921, **21**, 81.

[42] Reed and Halma, *J. Agr. Res.*, 1926, **32**, 1177.

[43] Webber, *C. A.*, 1921, **15**, 3131.

[44] Eaton, *Amer. J. Bot.*, 1927, **14**, 212.

[45] Bates, *J. Agr. Res.*, 1923, **24**, 131.

[46] Karrer, *Amer. J. Bot.*, 1926, **13**, 286.

[47] Iyengar, *J. Indian Inst. Sci.*, 1929, **12A**, 295.

tumourous growths comprising proliferous tissue[48] yield fluids of a lower concentration than the corresponding healthy tissues.

A fluid of higher density is obtained from shoots attacked by lac insects.[33]

B. *Refractive Index.*—Refractive index[49] offers a quick method of evaluating the total solids in a given sap and requires just a drop of the fluid, and has been extensively employed both in physiological research and in commercial practice, in estimating the sucrose content of cane juices.

C. *Depression of the Freezing Point*, Δ—*Osmotic Pressure.*—Depression of the freezing point is proportional to the total concentration of the osmotically active constituents of the sap, and gives a measure of its osmotic pressure. Dixon and his co-workers have employed this method in connection with their studies on the ascent of sap in plants.[50] The method has been adopted for elucidating the osmotic relations between hosts and parasites,[18,51] for understanding the nature of draught resistance[52] and winter-hardiness,[6,53,54,55] for a study of the changes accompanying the vegetative growth, fruiting and maturation of crops,[56,57,58,59] for obtaining an insight into the response of plants to changes of environment[2,60,61,62,63,64,65,66,67] and treatment, and for a study of pathological changes induced in the plant with the onset of physiological and parasitic diseases.[68,69]

About 5 c.c. of the tissue fluid suffice for a determination by Beckmann's cryoscopic method, but by Dixon's thermo-electric method,[70] the quantity can be reduced to 2 c.c. Still smaller quantities, (0·1 or 0·2 c.c.) can be employed for the determination by the "melting point method"; the liquid is placed in a capillary tube attached to a Beckmann's thermometer, and the freezing point determined by the disappearance of the liquid meniscus observed with a reading telescope.[71]

Factors which increase the concentration of crystalloids in the tissue fluids of an organism, are those which contribute towards a greater depression of the freezing point. Increased photosynthetic activity under the stimulus of light or artificial illumination, results in a concentration of sugars[72]; increased absorption of soil nutrients results in a corresponding enhancement of the inorganic constituents in the tissue fluids, particularly in the roots.[73] Conditions which favour transpiration also lead to a concentration of crystalloidal constituents of the sap and increase its osmotic pressure.

Minced tissue is often employed for the depression of the freezing point but the method yields higher values.[74]

Among the other methods of determining osmotic pressure are (1) the plasmolytic method, and (2) the drop method of Barger.[75] The relative merits of the plasmolytic and cryscopic methods have been discussed by Atkins.[76]

Mention may also be made of another term O_g—Osmotic value often employed and is defined as the molal concentration of cane sugar, which is necessary to effect

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[48] Harris and Gortner, *Biochem. Bull.*, 1915, **4**, 52.

[49] Gortner and Hoffman, *Bot. Gaz.*, 1922, **74**, 308.

[50] Dixon, *Transpiration and Ascent of Saps in Plants* (Macmillan & Co., Ltd.), 1914.

[51] Harris, *C. A* , 1919, **13**, 2898.

[52] Harris and Henry, *Hawaiin Planters Rec.*, 1930, **34**, 167.

[53] Sutherst, *Chem. News*, 1901, **84**, 234.

[54] Gail, *Bot. Gaz.*, 1926, **81**, 434.

[55] Maximov, Krasnosalskaia—Maximova, *Physiol. Abs.*, 1919, **4**, 413.

[56] Dixon and Atkins, *Sci. Proc. Roy. Dub. Soc.*, 1912, **13**, 219.

[57] Gail and Cone, *Bot. Gaz.*, 1930, **88**, 437.

[58] Lutman, *Amer. J. Bot.*, 1919, **6**, 181.

[59] Harris, Gortner and Laurence, *Physiol. Abs.*, **2**, 436.

[60] Drabble and Drabble, *Biochem. J.*, 1907, **2**, 117.

[61] Harris, Laurence and Gortner, *Physiol. Rev.*, 1916, **2**, 1.

[62] Fitting, *C. A.*, 1912, **6**, 766.

[63] Hector, *C. A.*, 1928, **22**, 3723.

[64] Blagoveshchenskii, Bogobyubova and Chernova, *C. A.*, 1928, **22**, 2590.

[65] Arrhenius, *C. A.*, 1920, **14**, 2358.

[66] Harris, *Amer. J. Bot.*, 1918, **5**, 490.

[67] Harris and Laurence, *Bot. Gaz.*, 1917, **64**, 285.

[68] Sprecker, *Physiol. Abs.*, **2**, 649.

[69] Iyengar, *J. Indian Inst. Sci.*, 1928, **11A**, 103.

[70] Dixon and Atkins, *Sci. Proc. Roy. Dub. Soc.*, 1910, **12**, 275.

[71] Drucker and Schreiner, *Biol. Zbl.*, 1913, **33**, 99.

[72] Dixon and Atkins, *Sci. Proc. Roy. Dub. Soc.*, 1916, **15**, 51.

[73] McCool and Millar, *Soil Sci.*, 1920, **9**, 217.

[74] Bouyoucos and McCool, *J. Amer. Soc. Agr.*, 1916, **8**, 50.

[75] Barger, *J. C. S.*, 1904, **85**, 286.

[76] Atkins, *Sci. Progress*, 1917, **11**, 562.

incipient plasmolysis.[77,78] The variation of Og serves as an index of the physiological activities of the tissue.

D. *Electrical Conductivity, K.*—The electrical conductivity of a sap is a measure of the total electrolytes present in a sap.[79] The depression of freezing point accounts for the crystalloids—both electrolytes, and non-electrolytes. From a knowledge of these two values, the concentration of non-electrolytes can be calculated and expressed in terms of cane sugar.

Conductivity measurements could be made with very small quantities of liquids—about 1 c.c. There is no particular advantage in using larger quantities. The choice of the conductivity cell depends upon the conductivity of the liquids; generally speaking for the investigation of physiological fluids, Arrhenius-Ostwald conductivity cell has been found convenient. The cell is provided with three sets of dip electrodes, differing from one another in the distance between the electrodes. In the case of tissue fluids with low conductivity, the one with the electrodes close to each other is employed.

Poisoning of the electrodes with the proteins of the sap is a common experience. To obtain reliable results, frequent platinising of the electrodes is necessary.

Conductivity determinations coupled with those of the depression of the freezing point, give useful information regarding the origin of osmotic forces in plants which may arise from two or more independent sources. Absorption of soil nutrients[80] and metabolic processes favouring the formation of organic acids, contribute towards conductivity, while an increase in photosynthetic sugars merely enhances the concentration of non-electrolyte crystalloids.

Conductivity measurements are affected by the viscosity[81] and in the case of mucilaginous saps, the effect may be appreciable. The suppression of dissociation due to the mutual action of salts and acids[79] also affects the results for the total electrolyte content through conductivity measurement. A rough relationship has been found to exist between conductivity and inorganic constituents of saps as determined by ash content, and for most purposes the conductivity may be taken as a rough estimate of the ash content of the tissue fluids.

E. *H-ion Concentration and Buffering Capacity of Tissue Fluids.*—There is a vast amount of literature on this aspect of plant physiology. The importance of hydrogen-ions as a regulating mechanism for many of the vital processes of plants, has long been recognised and a large number of methods have been developed for its determination. The usual methods consist in measuring the potential of a hydrogen electrode dipping in the sap against the standard calomel electrode. The hydrogen electrode can be replaced by quinhydrone, antimony or other electrodes. An elegant glass electrode suitable for working with a few drops of tissue fluid has been described.[81] The quantity of fluid necessary for the determination depends upon the apparatus employed; 3-5 c.c. are required for Clark's electrode.[82] Haas[83] describes an electrode vessel suitable for work with 3 to 4 drops of plant juice. With the modified micro-electrode of Bodine and Fink,[84] the quantity may be reduced to 0·25 c.c. to 0·01 c.c. depending upon the size of the electrode vessel. The latter can function either as a hydrogen or quinhydrone electrode. Further refinement has been secured by Taylor and Whittaker[85] who succeeded in constructing a micro-non-polarisable electrode which can be used for determining the hydrogen-ion concentration of living cells and tissues, with great accuracy. The capillary electrode devised by Robertson and Smith[86] is suitable for measurement of pH at a point *in situ* of the plant tissue, and can therefore be employed for surveying the pH values at various points of an organ, and also in such of those cases, where the tissues during pulping suffer chemical transformations leading to an alteration in the pH values.

Hydrogen-ion concentration in the cell sap without expression from the cell has been

[77] Beck, *Plant Physiology*, 1928, **3**, 413.
[78] Beck, *Ibid.*, 1931, **6**, 315.
[79] Haynes, *Biochem. J.*, 1919, **13**, 111.
[80] Hoagland, *Bot. Gaz.*, 1919, **18**, 297.
[81] MacInnes and Doll, *J. Gen. Physiol.*, 1929, **12**, 895.
[82] Clevenger, *Soil Science*, 1919, **8**, 217.
[83] Haas, *Soil Science*, 1920, **9**, 341.
[84] Brunstetter and Magoon, *Plant Physiol.*, 1930, **5**, 249.
[85] Taylor and Whittaker, *Protoplasma*, 1928, **3**, 1.
[86] Robertson and Smith, *J. Soc. Chem. Ind.*, 1930, **49**, 120.

measured both electrometrically and colorimetrically. Such *in vivo* studies of the properties of the cell sap represent a great improvement over the *in vitro* study of saps and there is a fruitful field in this line for developing the *in vivo* technique for elucidating the nature of the cell sap. Mention may also be made of the Range Indicator Method by Small and his co-workers[87,88,89] which has proved invaluable in studying the reaction of individual cells and their variations due to seasonal factors.

For rapid work, particularly field work, colorimetric methods are available, where a series of indicators, each measuring a different range of hydrogen-ion concentration, are employed. For coloured solutions the method is unsuitable. Further the colorimetric method is affected by the 'salt' and 'protein' errors and does not yield accurate results. Arland[90] has carried out comparative studies of the potentiometric and colorimetric methods. Domontvich[91] finds fair agreement between hydrogen and quinhydrone electrodes.

The simple quinhydrone electrode is unsuitable to saps not because of the 'salt' error which is negligible with the concentration of salts obtained in the tissue fluids, but is due to the presence of sugars and phosphates. Billmann and Katagiri[92] have shown that the use of the hydroquinhydrone electrode gives reliable values.

The concentration and reaction of the nutrient solution in which the plant thrives does not greatly influence the hydrogen-ion concentration of the sap[93] but the root sap responds to the soil acidity and builds up a buffering mechanism to withstand the adverse effects of soil reaction. The buffering capacity is influenced by ions—potassium and phosphorus enhancing and calcium and chlorine lowering the capacity.[21] A marked diurnal variation[94] in the hydrogen-ion concentration has been observed, not to speak of the seasonal and regional fluctuations.[87] The external factors appear to influence only the outer cells of the plants and the inner cells enjoy a greater uniformity with respect to the hydrogen-ion concentration. There is a gradient in the pH from the top to the root.[95] Application of fertilizers like potash and phosphate tends to increase and nitrogenous manures decrease the pH.[96]

The effect of CO_2 produced as a result of respiration, on the buffering of the living cells deserves extended investigation. Instances are known where the CO_2 content may be as high as 20–30 per cent.[97] The CO_2 balance in a plant sap is comparatively little investigated. Our knowledge on the subject is mainly due to the work of Ingold,[98] Willman and Brown,[99] Small[100] and others. The extent to which CO_2 exists in the dissolved condition is important in the photosynthetic activity of the plants.

The methods of identification of plant acids have been investigated by Czapeck.[101] More recently Iyengar[102] has examined the acids in the tissues of healthy and spiked sandal plants. The acidity changes are particularly marked when the physiological state of the plant is upset by the entry of parasites through adverse environmental conditions. Reduced root activity due to phylloxera attack on vines lead to high acidity of plant saps.[14] The stem weevil attack of cotton leads to an increase in alkalinity.[103] In cases of tumour growth and proliferous tissue there is a decrease in hydrogen-ion concentration.[104] Disease resistance in grape vines[14] is characterised by a high acidity, a low sugar content, and a poor oxidase activity. In the case of the tobacco root rot it has been found that low soil acidity favours the incidence of disease. The subject has been investigated by Morgan and others.[105]

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87 Rear and Small, *Protoplasma*, 1927, **2**, 428.

88 Ingold and Small, *Protoplasma*, 1928, **3**, 458.

89 Small, "Hydrogen-ion concentration in plant cells and tissues," *Verlag von Gubruder Borntraeger, Berlin*, 1929.

90 Arland, *C. A.*, 1925, **19**, 2225.

91 Domontvich, *C. A.*, 1927, **21**, 3217.

92 Billmann and Katagiri, *Biochem. J.*, 1927, **21**, 441.

93 Arrhenius, *Physiol. Abs.*, 1922, **8**, 375.

94 Truog and Meacham, *Soil Science*, 1919, **7**, 469.

95 Gustafson, *Amer. J. Bot.*, 1924, **11**, 1.

96 Miyake and Arachi, *J. Biochem.* (Japan), 1924, **4**, 317.

97 Magness, *Bot. Gaz.*, 1920, p. 308.

98 Ingold, *Protoplasma*, 1930, **9**, 456.

99 Willman and Brown, *Plant Physiology*, 1930, **5**, 535.

100 Small, *New Phytologist*, 1920, **50**, 19.

101 Czapeck, *Biochemie der Pflanzen*, 1923, **3**, 99.

102 Iyengar, *J. Indian Inst. Sci.*, 1933, **16A**, 139.

103 Lakshmana Rao, *Madras Agr. Dept. Year Book*, 1926, p. 65.

104 Harvey, *Amer. J. Bot.*, 1920, **7**, 211.

105 Morgan, Anderson and Dorsey, *Connecticut Agr. Exptl. Stn. Bull.*, 1929, No. 306.

The buffering capacity of a particular fluid is connected with its chemical make-up, which consists mainly of organic acids, their salts, and phosphates.[106-109] This has been amply demonstrated in a number of plant juices. In fact, the salt content of a juice can be determined with a fair degree of accuracy through a determination of the pH and titratable acidity and referring to a table showing the relationship between titratable acidity and pH of related artificial buffer mixtures.[110] Proteins play a negligible rôle in the buffering systems. This is not surprising as a consideration of the basis of the buffering capacity will show that it is an ionic phenomenon and the proteins possess a large molecular weight.

The buffer index β is equal to $\frac{dB}{dpH}$ where dB is the gramme-equivalent concentration *per litre* of added base and dpH is the observed change in the pH when the quantity dB is added to the solution when buffer index is being determined. The introduction of the conception of the buffer index[111] has largely served to clarify our conceptions regarding buffers.

The midrib and petiole sap of a leaf has less buffer effect compared with that derived from the rest of the leaf. In the intact cell, the cell wall itself resists the change in acidity of the cell contents due to external H^+ or OH^- and thus acts as a buffer. This was demonstrated in the case of *Nitella* by Hoagland and Davis.[112]

Buffers offer a fine mechanism through which the hydrogen-ion concentration is maintained at a particular optimum. On account of this mechanism, the reaction of plant cells is not affected by fluctuations in the reaction of soil medium, by the violent metabolic disturbances caused by the invasion of parasitic organisms or changes of environment. In fact the buffering capacity has been considered to be a measure of disease resistance.

Glycerine, sugars and alcohols increase the dissociation of acids and therefore act as negative buffers,[113] and an abnormal accumulation of these products always renders the plant susceptible to fungus infection.

Other Physico-Chemical Measurements.—There is little literature regarding a study of viscosity or surface tension of plant saps. A determination of the viscosity of saps would provide useful data for obtaining an idea of the hydrophillic colloid content and perhaps throw some light on the ascent of sap in plants.

The optical activity of a plant sap is not usually determined since the concentration of the optically active constituents in the sap are generally small except in special instances like cane juice, when this method is extremely valuable in assaying the sucrose content. Further, the method is not directly applicable to the great majority of plant tissue fluids which, being coloured, have to be treated with clarifying agents before a determination can be carried out. The method is no doubt a valuable one which merits a wider employment and should be extended to a determination of the exaltation in optical activity after addition of borates or arsenates. This will differentiate hydroxy compounds, *e.g.*, sugar alcohols like mannitol and organic acids like tartaric. If an appreciable exaltation is obtained, the presence of such or related compounds should be suspected.

Physico-Chemical Data: Their Interrelationships and Interpretations.—The depression of the freezing point is a measure of the total concentration of the osmotically active substances in solution, which include, not only the crystalloids in true solution but also the colloidal micelle with different osmotic valencies. The conductivity measurements give an idea of the total concentration of the electrolytes and the colloidal micelle carrying ionic charges. The non-electrolytes like sugars and the colloidal micellæ which do not carry any effective charge but which are osmotically active do not contribute towards the electrical conductivity of the solution. If therefore we have the depression of the freezing point, Δ, and the electrical conductivity K, we can obtain a ratio of the two values $\frac{K}{\Delta}$ which indicates changes in relative concentration of ions in relation to total solutes. This ratio has been determined in a great number

[106] Martin, *Protoplasma*, 1928, **3**, 273.
[107] Martin, *Ibid.*, 1928, **3**, 282.
[108] Ingold, *Ibid.*, 1929, **6**, 51.
[109] Ingold, *Ibid.*, 1930, **9**, 447.
[110] Haynes and Brown, *Biochem. J.*, 1928, **22**, 947.
[111] Van Slyke, *J. Biol. Chem.*, 1922, **52**, 525.
[112] Hoagland and Davis, T., *Gen. Physiol.*, 1923, **5**, 629.
[113] Lenthardt, *Kolloidchem. Beihefte.*, 1927, **25**, 1.

of investigations. In the case of the sandal leaves, the ratio is lower in spiked sap than in normal material; on the other hand, the sap derived from shoots attacked by lac insects has been found to possess a higher ratio.

The average molecular weight of the solutes can be computed from (1) the total solids of the sap (C) and (2) depression of the freezing point, Δ.

$$M = C. \frac{K}{\Delta}$$

where K=1000 × molecular lowering for a given solvent.

It has been found that host plants of lac reputed to yield thick encrustations of lac, contain a sap whose solutes have a high average molecular weight, indicating the existence of high molecular compounds favouring the production of resin. The tissue fluids of the sandal leaf in the diseased condition contain solutes whose average molecular weight is low and indicate a disintegration of the high molecular proteins. It should be possible to make a further differentiation between the mean molecular weight of the electrolytes and that of the non-electrolytes in the sap, by taking into consideration the data for electrical conductivity. An attempt in this direction may lead to significant results.

Obituary.

Reverend Ethelbert Blatter, S.J. (1877—1934).

REVEREND FATHER ETHELBERT BLATTER was born at Rebstein in Switzerland on the 15th September 1877. He received his early education at the Benedictine School at Sarnen in Unterwalden and later at Schwyz where he devoted himself to the study of modern languages. He joined the Society of Jesus on the 15th October 1896. This step caused great surprise among his numerous friends and relatives, for to them it seemed well-nigh unbelievable that the boisterous jovial, well-to-do lad they had known should decide to be one of the Jesuits. After completing his studies in Philosophy, he applied himself almost exclusively to the study of Botany. He came out to India in 1903 as Professor of Biology at St. Xavier's College, Bombay. After a stay of six years in India he went back to Europe in 1909 to complete his ecclesiastical studies and was finally ordained a priest on the 25th August 1912. On his return to Bombay in 1915 he once more took up work as Professor of Biology at St. Xavier's College of which he later became the Principal in 1919. In 1925 Father Blatter retired from his professorial duties to Panchgani where he remained till almost the end of his life. He passed away peacefully on the 20th May 1934 at St. Vincent's High School, at Poona.

From the period of his arrival in India in 1903 dates the commencement of a stream of publications in Botany which continued until his death. Father Blatter devoted his time and energy to the study of the Asian flora. He travelled extensively and made large collections which formed the basis of his writings. His most important contribution between 1903 and 1909 was the "Palms of British India and Ceylon" published later in book form by the Oxford University Press. While in London he compiled "the Flora of Aden" and "the Flora of Arabia". With all the material he was collecting he built up a fine Herbarium which is now in St. Xavier's College. In 1926 he undertook to revise the "Flora of the Bombay Presidency" first published by Cooke. Twenty-one parts of this work have already been published. Among his other important publications, some of which are in collaboration with other workers, are "the Flora of the Indus Delta" "the Flora of Beluchistan," "the Flora of Waziristan," "the Ferns of Bombay," and "the Flowers of Kashmir". A monograph on "the Bombay Grasses" by Blatter and McCann is in course of publication.

He served the Bombay University in many capacities as a member of the Senate, the Syndicate and the Science Faculty, and he had much to do with the present University Reforms. He was the Vice-President of the Bombay Natural History Society and gave of his best to that Society. He was elected President of the Botany Section of the Indian Science Congress in 1926 and the President of the Indian Botanical Society in 1927.

In recognition of his work in Botany Fr. Blatter was awarded the Johannes Bruehl Memorial Medal for the year 1931. It was

a fitting tribute to his pioneer work on Asian Flora.

As a man Father Blatter was kind-hearted and generous, full of wit and humour, which never forsook him even under the most trying conditions of his health. His life was a selfless one, true to his calling as a Jesuit and to the science he loved. His premature death is a great loss to the science of Botany to which he rendered outstanding services.

R. H. D.

* * *

Professor P. Sampat Iyengar, M.A.

IT is with deep regret that we record the premature death, on Tuesday, 24th July 1934, of Mr. P. Sampat Iyengar, retired Director-Professor of Geology in Mysore, at the early age of 55.

As an officer of the Mysore Geological Department for nearly thirty years, Mr. Sampat Iyengar published numerous important papers in the Records of the Department, and was largely responsible for formulating many of the fundamental ideas regarding the Geology of Mysore which are even to-day guiding the work and shaping the policy of the Mysore Geological Department. His address on "The Acid Rocks of Mysore" from the Presidential Chair of the Geology Section of the Indian Science Congress (Nagpur 1920) still stands as a valuable and authoritative statement on this aspect of Mysore geology. His very intimate and intensive knowledge of the Archæan rocks, both in and outside Mysore, together with his ripe experience and mature judgment in this field of study naturally gave him a prominent place in the foremost ranks of Indian geologists.

As Professor of Geology in the Mysore University for 12 years Mr. Sampat Iyengar was actively associated with the work of the University; and the present leading position which the Geology Section of the University occupies among similar institutions in India and the reputation which it enjoys as a place for instruction and centre of research, is in no small measure due to his untiring endeavours.

Apart from his eminence as a geologist, the late Mr. Sampat Iyengar possessed certain admirable traits of character which largely contributed to make his personality really 'dynamic'. An honest and wholehearted devotion to duty, a burning enthusiasm for work, a frank and fearless expression of views, a stern sense of discipline and an uncompromising adherence to principles —these were some of Mr. Sampat Iyengar's outstanding virtues for which he will ever be remembered.

In his private life, Mr. Sampat Iyengar was orthodox, simple, and unostentatious. By his genial manners and genuine affection he had formed a large circle of friends to many of whom his death comes with all the poignancy of a personal bereavement.

L. RAMA RAO.

* * *

WE deeply regret to announce the death of Dr. S. K. Mukerjee, M.Sc. (Allahabad), D.Sc. (London), Reader in Botany at the University of Lucknow, Honorary Secretary of the Indian Botanical Society, Fellow of the Linnean Society of London. He died at Lucknow on August 5, 1934, after a brief illness at the age of about 37 years.

An Alternative Atom.

IN a letter addressed to the *Sunday Statesman* (Aug. 5, 1934) Dr. R. Samuel, Dr.Phil. (Göttingen), F.Phys.Soc., Professor of Physics, Muslim University, Aligarh, has critically examined the theory of Dr. Tutin concerning the structure of the atom. Dr. Tutin's attack on the classical Rutherford-Bohr atom, which has received much publicity in the non-scientific press, according to the Professor, is "ill-founded and far from the truth." "In order to construct quantised orbits of the order of magnitude of the atoms, he has to assume new electrical forces of non-Coulombian character, which have never been observed and for whose existence there is no evidence whatever. In order to explain Rutherford's experiments on the scattering of X-particles, he has to ignore these forces later on but in spite of this he is not able to come to an agreement between his theory and experimental results. Since in his theory the mass of the atom is not concentrated in the nucleus but assumed to form mainly the outer sphere of the atom, the theory falls into terrible and ridiculous difficulties, the moment he deals with isotopes. These few arguments may be sufficient to show that 'all his results are just pious hopes and no more, and most of them are demonstrably wrong'."

Letters to the Editor.

Priority in Lac Research.

USUALLY lac insects have two life cycles but O'Conor[1] mentions localities supposed to yield three crops of lac per year. Imms[2] and Chatterjee confess inability to refer to their source of information in their publication but mention having tried to discover a trivoltine insect. In a paper published in 1919, I[3] made myself responsible for such a positive finding with regard to Mysore. The late Mr. Howlett, when he visited Bangalore as a Member of the Lac Enquiry Committee, expressed hesitation in believing this fact and I offered to convince him by sending brood lac at a time when only a trivoltine species could yield larval swarming. In their joint Report issued after Howlett's demise, his colleagues Lindsay[4] and Harlow write: "The fact that we are still unable to say whether there is a trivoltine variety....is an indication of the extent to which its general study has been neglected.....Whether this is the case or not remains to be seen but it is interesting to note that from *Shorea talura* in Bangalore which originated from a swarm in the latter part of December (larvæ) swarmed on 21st April 1921, a remarkably early date. This seems to be the most definite evidence as yet available ...." The brood lac referred to was sent by me and I had hoped to read a confirmation of my discovery in the interests of the lac industry or a mention of my name. On the contrary the report devotes two pages criticising some of my theories which have since been substantiated by the findings of Sreenivasaya and myself. I had reasons to protest against an attitude where the report was loud in declamation and silent in recognition, both to my disadvantage. I consulted the then Director of the Indian Institute of Science who gave me to understand that it is immaterial for Science, who says it; the publicity of a discovery after all is the main objective of every worker. This altruistic principle, however, loses its hold on the mind as memory gathers further sad experience.

When Howlett came to Bangalore he received a typescript report of another work containing about 25 photographic illustrations on which Fowler[5] writes, "Mr. Mahdihassan has spent some months in the Department studying the anatomy and physiology of the lac insect. With the aid of the Minot Microtome he has made a number of interesting sections and claims to have succeeded in identifying the special glands concerned with the production of the various substances found in stick lac, *viz.*, wax, hard and soft resins, etc. The work has been submitted to the Officers of the Government of India conducting a special enquiry into the subject of lac." In the Report on Lac by Lindsay[4] and Harlow no mention is made, however, of this fact. On the contrary the *Ann. Rep. for 1919-20 of the Board of Scientific Advice for India* (Pub. 1921), contains the following statement from Beeson: "A microscopic examination of the internal morphology of lac insects has been carried out under the direction of Mr. F. M. Howlett with the object of discriminating specific differences in the form of lac insect from different kinds of host tree." If this had been the object of research, it was more likely that the external morphology of insects from different trees would first be studied. At any rate, similar problems, for example, distinguishing different species of phylloxera forming galls on the grape vine, have never been attacked in the complicated way suggested above. I addressed an enquiry to Dr. Beeson at Dehra Dun who kindly referred me to Mr. Fletcher at Pusa who was equally unaware of the work done under Mr. Howlett's direction. In the light of my experience a subtle difference had to be made between Howlett's work, which no doubt his successors at Dehra Dun or at Pusa could have easily traced out, and work done elsewhere, supposed to have been carried out under his direction but completed and its typescript report handed even before the suggestion was ever offered. At the same time when Howlett received my work, copies were also sent to the following:— Prof. Tschirch of Bern, Switzerland, the authority on Resins who had the kindness of mentioning in more than one of his

[1] O'Conor, *Note on Lac*, 1874, Calcutta.
[2] Imms and Chatterjee, *Ind. For. Mem.*, 1915, **3**, Pt. 1.
[3] Mahdihassan, *Quart. J. Mysore For. Assoc.*, 1919, No. 3.
[4] Lindsay and Harlow, *Ind. For. Rec.*, 1921, **8**, Pt. 1.
[5] *Appendix, Eleventh Annual Report of the Council, Indian Inst. Sci.*, Bangalore, 1920, 8.

publications that the internal anatomy of the lac insect had been studied by me; Prof. Bugnion then at Lausanne an authority on wax glands; Prof. Silvestri of Portici who was proposing to write a monograph on lac insects; Prof. Ferris of Stanford, California, who was equally interested in lac insects, and Dr. Imms then at Rothamsted. The Director of Industries, Hyderabad, also received a copy and another was deposited at the Indian Institute of Science, Department of Applied Chemistry. Under the post-war economic conditions, even in Germany then, an accepted thesis did not receive greater publicity than had been the fate with my work.

My histological paper entitled "Seats of the Origin of Lac Products" recognised stick lac as a concrete where besides lac, several kinds of wax form an inner structure. I had attempted to show the glands responsible for the secretion of each of these products. In a later publication[6] several indications have been made to previous histological findings, *viz.*, "Throughout the undersurface of the skin there are dermal glands. They have long chitinous ducts and with these they look like toy balloons." Prof. Misra[7] in criticising all previous workers generally and Chamberlin particularly says that they "do not mention the presence of any glandular structure associated with these pores". In his historical introduction he entirely ignores the histological findings casually mentioned in my paper of 1923 which he, however, critically refers to in another connection in the same paper. Misra claims "the lac glands are being described and figured here for the first time". I assert that Misra was not the first to have seen these glands; at any rate, he has not given a more exhaustive description than that contained in the very short passage quoted above from me. His illustration of ducts shows them to be wavy and the glandular structures, therefore, resemble spermatozoa. The ducts are of hard chitin and hence they possess a rigidity similar to a wire. I am not interested here in criticising his results but in pointing out that he has ignored my previous findings. In my publication, I have repeatedly emphasised the presence of hard and soft waxes in stick lac. A histologist would have found wax glands instead of "special lac glands" as named by Misra which is misleading, as it only lends to the assumption that stick lac is a homogeneous substance. Misra's publication is a result of academic work and it is surprising that there should have been other glaring omissions in acknowledging previous work. It may be particularly pointed out that Fig. 1 (B) and Fig. 3 both on Pl. 1 of Prof. Misra's[7] paper, are similar to those already published by Rai Bahadur Misra[8] and by Chamberlin[9] respectively.

It is hoped that in future such plagiarisms will be avoided; that unhealthy rivalry and duplication will be discouraged; and that scientific workers will develop a spirit of genuine research with a sense of responsibility.

S. MAHDIHASSAN.

Hyderabad,
Deccan,
July 24, 1934.

[6] Mahdihassan, *J. Sci. Assoc., Vizianagaram*, 1923, **1**, No. 2, 86.

[7] Misra, *Proc. Zool. Soc., London*, 1931.

[8] Rai Bahadur Misra, *Pusa Bull.*, 1923, No. **142**, 10, Fig. 2.

[9] Chamberlin, *Bull. Ent. Res.*, 1923, **14**, Pt. 2, Pl. X, Fig. D.

Influence of Moon on Earthquakes.

IT is well known that the shape and position of the continents with their high mountains and seas, owe their origin to the great upheavals that have taken place millions of years ago and that are still going on in a moderate scale within the crust of the earth. Some think that the forces which have caused these changes are due to cooling of the earth's crust, while others think that they are due to polar movements caused by the rotation of the earth. Whatever might be the cause, these great upheavals have brought about regions of instability within the crust of the earth, and whenever there is a fresh dislocation due to tectonic movements mentioned above, an earthquake occurs. It is supposed that astronomical bodies, such as Sun and Moon, have no influence in precipitating a quake. It seems, however, that though the astronomical bodies are incapable of precipitating a dislocation, yet they are able to magnify the movement if they can exert their maximum influence during a dislocation.

If the forces due to Moon and Sun act in the direction in which the dislocation of the crust occurs, then obviously the displacement will be greatly magnified, and would

set a devastating earthquake. One is therefore led to suppose that when a quake occurs under such conditions it must spread over a large area and produce great destruction of life and property. It is significant that during the undermentioned Earthquakes *viz.*—

(1) Assam quake (1897) 4-25 p.m., 12th June;

(2) North Bihar quake (1934) 2-25 p.m., 15th January;

(3) Kangra quake (1905) 6 a.m., 4th April;

the positions of the Moon were as follows:—

(1) Moon away from the Sun by about 150° east, *i.e.*, anti-Moon 30° west of Sun.

(2) New Moon.

(3) New Moon.

If we examine Figs. 1 to 3 we see that

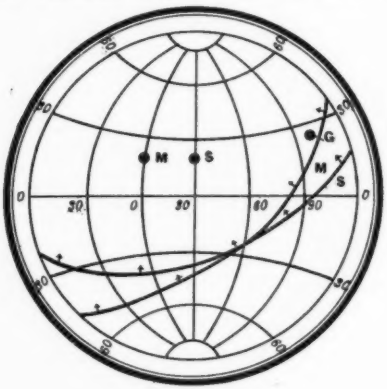

Fig. 1.
Assam Quake.
4-25 p.m., 12th June 1897, Near New Moon.

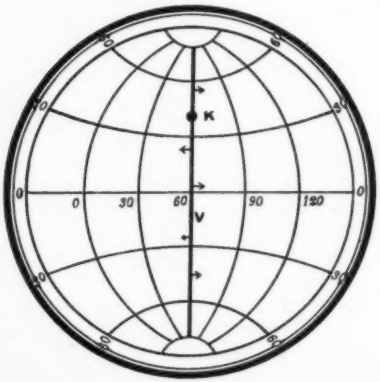

Fig. 2.
Kangra Quake.
6 a.m., 4th April 1905, New Moon.

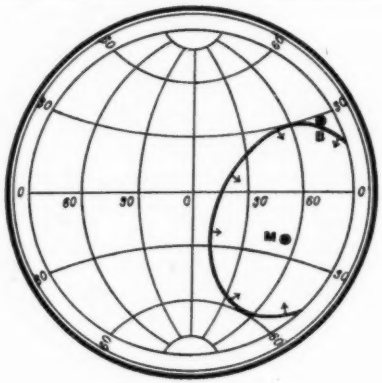

Fig. 3.
North Bihar Quake.
2-15 p.m., 15th January 1934, New Moon.

during Assam quake and Kangra quake the vertical tide producing forces influenced the epicentral tract, while in North Bihar quake, the horizontal forces passed through the earthquake area.

Regarding these forces R. D. Oldham wrote long ago:—"With all these objections there remains a sufficiently strong case for the reality of the influence of these forces in determining the time and origin of earthquakes to justify a fuller investigation." It is considered that a fuller investigation of all the devastating quakes might lead to the establishment of a definite law regarding the magnifying influence of the forces due to Moon.

R. N. GHOSH.

152, South Malaka,
Allahabad,
May 16, 1934.

Fruit and Seed Development in *Tinospora cordifolia* Miers without Fertilisation and Embryo Formation inside.

As the internal morphology of the ovule in the family Menispermaceæ is not much known, during the years 1932 and 1933, the undersigned fixed for investigation a large amount of material of *Tinospora cordifolia* Miers from plants growing in the local botanical garden. This included a large number of fruits in different stages of development, beginning with the carpels of flowers that had just withered and ending with the mature red drupes, and was meant for the study of embryogeny in the species.

We have, however, been surprised to find the total absence of embryos in all this material. The ovules have been found to develop quite normally upto the formation of the embryosac. The megaspore-mother cell gives rise to a complete row of four megaspores. The chalazal one of these develops into an 8-nucleate embryosac of the usual type. The megaspore-mother cell, the linear tetrad of megaspores and the embryosac are deep-seated, the embryosac being covered by about ten layers of parietal tissue. It shows an egg-apparatus of the normal form at the micropylar end, two polar nuclei about the middle, but slightly towards the micropylar end, and three antipodals at the chalazal end. The last resemble those of certain Ranunculaceæ[1] in shifting their position towards one side as the embryosac increases in size during endosperm development. On the contrary, no pollen on the stigmas of the carpels or any pollen-tubes penetrating the nucellus of the ovule have been seen even in more than two hundred ovules examined for the purpose. No fertilisation takes place and the various parts of the embryosac except the two polar nuclei gradually degenerate. The parts of the egg-apparatus lead in the process and then a little later the antipodals share the same fate. The behaviour of the polar nuclei is just the reverse. They fuse with each other in the micropylar half of the embryosac to give rise to a secondary nucleus and the latter without undergoing the process of triple fusion divides to form a large amount of endosperm. The growth of the endosperm on the ventral side of the carpel is very irregular and it consequently becomes ruminate. Along with the development of the endosperm, the embryosac goes on increasing in size and absorbing the nucellus. The integuments of the ovule change into the testa of the seed and the wall of the ovary differentiates into the epicarp, fleshy mesocarp and the stony endocarp of the drupaceous fruit, without any embryo being formed inside.

This absence of embryos in the seeds of apparently normal fruits of *Tinospora cordifolia*, we have also confirmed by dissecting many of them, though it is not possible to put forward any exact cause for the failure of pollination, which appears to be the primary cause for such a development. In the Benares Hindu University Botanical Garden while there are a number of female plants, there is only one male plant at a distance of a few hundred feet from the former. The pollen of this male plant is quite normal; and although no germination experiments have been tried, it appears from its structure to be quite viable. The lack of pollination may be, therefore, due only to the distance between the male and the female plants, the effect of which is enhanced by these plants growing on other trees often with dense foliage, like the mango. But whatever the explanation may be for the lack of pollination, it is quite clear that *in 'Tinospora cordifolia' without the stimulus of fertilisation and without the development of embryo inside, apparently normal seeds and fruits are formed.* In this respect, a comparison can be made with Kashyap's observation in Lahore on the ovules of *Cycas revoluta*.[2] There are only female individuals of this cycad in Lahore, but even then the ovules develop into seeds, which externally look quite normal. Inside only the female gametophyte is developed and there is no fertilisation and embryo formation. As the cause of such a development in *Cycas revoluta*, Kashyap suggested the possible influence of some foreign pollen. In angiosperms, the morphology of the endosperm being different, it is not unlikely that in *Tinospora cordifolia*, the necessary stimulus for the development of the seed and fruit may be coming from the formation of endosperm itself inside and its formation without fertilisation is not an unusual thing even in the Ranales.

A. C. JOSHI.
V. V. RAMAN RAO.

Department of Botany,
Benares Hindu University,
June 9, 1934

[1] Coulter, J. M., *Bot. Gaz.*, 1898, **25**, 73.

[2] Kashyap, S. R., *J. Ind. Bot. Soc.*, 1921, **2**, 116.

Kinks on Impact Curves of Struck Strings.

THE present note is meant to indicate that Kaufmann's theory is sufficient to explain the phenomena associated with struck strings, specially with reference to Pianoforte where the striking length a and the elastic strength of the felt hammer are small. In this case particularly Kaufmann's theory when modified for elasticity can be applied with advantage. In order to do this divide the total duration of impact into

two parts: (1) the interval during which the string is not displaced while the hammer felt undergoes compression till at the end of this interval; the second (2) regime begins and the string is displaced from the equilibrium position when Kaufmann's assumption holds good. It may be mentioned that this mode of considering the phenomenon first pointed by the authors in 1930 (*Phil. Mag.*, **9**, 1175, 1930) has also been accepted by Messrs. Ghosh and Kar of Calcutta, (*Phil. Mag.*, **17**, 521, 1934). Now Kaufmann's assumption is

$$\dot{Y} = \dot{Y}_0 \frac{x}{a} \qquad .. \qquad .. \quad (1)$$

initially at the beginning of second regime without any displacement, and at any subsequent instant the displacement is given by

$$Y = Y_0 \frac{x}{a} \qquad .. \qquad .. \quad (2)$$

where $\dot{Y}_0$ and Y_0 are velocity and displacement of the striking point abscissa $x = a$ measured from the nearer end.

A distribution of velocity in the position a given by (1) and without any displacement has been shown by Sir C. V. Raman, N.L., to be due to discontinuous velocity waves (Fig. 1); one set travelling positively, and

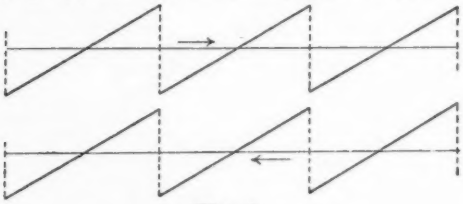

Fig. 1.
Discontinuous Velocity Diagram.

the other negatively. These produce displacements similar to that of bowed string, which appear as small kinks (Fig. 2) in the

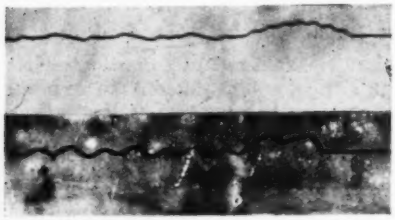

Fig. 2.

Fig. 3.

time displacement diagrams of any point of the string between the nearer end and the striking point, obtained during the time the hammer is in contact with the string. In fact Kaufmann's theory with slight modifications is sufficient to explain the presence of these kinks in the shorter portion, their absence at the striking point and on the longer side of the string. It is also adequate to explain the appearance of large kinks when a is increased and the length of the other portion is decreased. Fig. 3 shows a large kink, $a = 30{\cdot}7$ cms.; $\beta =$ the point of observation 106 cms.; $\frac{T}{\phi} = \frac{\text{Period of vibration of the string}}{\text{Duration of contact}} = {\cdot}7$; while Fig. 4 shows the same drawn theoretically. Details will appear elsewhere.

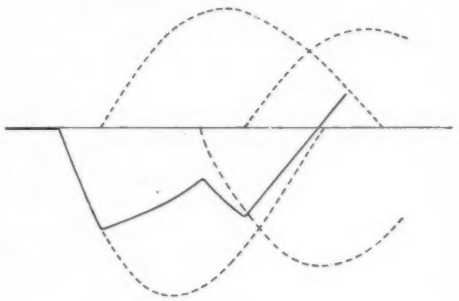

Fig. 4.

R. N. GHOSH.
HAJI GULAM MOHAMED.

Physics Department,
Allahabad University,
Allahabad,
June 21, 1934.

Molecular Weight of Lignin.

THE highest yield of formaldehyde recorded by Freudenberg and co-workers[1] from pine-wood lignin is 1·2 per cent. Depending mainly on this result they advanced a structural formula for lignin[2] corresponding to a molecular weight of 2140 (in unpolymerised form). But as the molecular weights of various lignin derivatives lie between 800 and 1000,[3] it is difficult to reconcile Freudenberg's figure with these. The di-oxymethylene group has been found to be very unstable towards acids and by treating jute with 42 per cent. HCl at 20° for 24 hours a lignin has been obtained with a pale rose colour which after repeated washings with

[1] *Ber.*, 1933, **66**, 262.
[2] *Cellulose Chemie.*, 1931, **12**, 269.
[3] Fuchs, *Chemie des Lignins*, 1926, 178.

dilute NaOH, gives 2·78 per cent. of formaldehyde (estimated by the Dimedone method).

Unlike aliphatic compounds, aromatic bodies with $O–CH_2–O$ groups do not give formaldehyde quantitatively by acid hydrolysis—the phenolic groups combine with the HCHO liberated to give resins; the temperature and concentration of acid employed for the estimation of HCHO being the same as those suitable for resin formation.[4] In the case of piperonylic acid 77·6 per cent. HCHO was obtained—also when HCHO and excess of protocatechuic acid were distilled with 28 per cent. H_2SO_4 very nearly the same percentage was obtainable.

Assuming as Freudenberg does, that only one $O–CH_2–O$ group is present in lignin and also that 2·78 per cent. HCHO represents 77·6 per cent. of theory, the molecular weight comes to 830. Rassow and Wagner[5] determined the molecular weight of glycol-lignin by Barger-Rast method and gave the figure as 840. Freudenberg's formula therefore needs modification.

PULIN BEHARI SARKAR.

Chemical Laboratory,
Dacca University,
July 15, 1934.

Equisetum in Gujerat.

THE occurrence of *Equisetum* at Poona is perhaps the only record of its existence in the Presidency of Bombay.

The writer came across a dwarf (about six inches) but fertile specimen of *Equisetum* in October 1931 at Malsar in the Baroda State. The plant was isolated in a cleft formed by hardened clay in the bed of the river Narbada. It was supposed to be an accidental exotic in a district where ferns are rare or none.

This year at the end of May, I happened to visit a place called Balaram fifteen miles N.-E. of Palanpur. It is one of the outlying hills of the Aravalli range on the river Banas. Here, I found the shady slope of the hill covered all over by *Equisetum*. The fine green plants about twenty-four inches in height on hard limy soil apparently enjoyed the hot weather (115° temp.). They had stout dark rhizomes and a few branches but no cones.

This find of *Equisetum* at two different places about hundred miles apart in Gujerat and that too, one from a place supposed to be arid and sandy is worth noting.

S. C. DIXIT.

Wilson College,
Bombay,
July 1934.

Fluorescence in Wood under Ultra-Violet Light.

WHILE we were engaged on the study of the fluorescence in wood, under ultra-violet light, a short paper by Dalton on 'Woods that shine in the dark', appeared in the *Canadian Woodworker and Furniture Manufacturer*, 1934, p. 9. In this note certain observations have been made which are not in accordance with our findings and we, therefore, take this opportunity to record the results of our preliminary examination, a detailed account of which will appear elsewhere. Dalton remarks that "with the new Argon ultra-violet glow lamps and suitable light suppressing filters a large number of wood specimens were found to possess very definite fluorescent features. In practically all instances, the fluorescence was of a yellowish green colour."

We have examined over a hundred specimens in wood blocks, and in powder form, as well as their extracts in some common organic solvents, under a 'Hanovia' Quartz Mercury Vapour Lamp fitted with Wood's filter. We find that most of the woods fluoresce, the colour of the fluorescence in the block form and in the powder form being practically identical but, in many cases, different from the colour of the fluorescence of their extracts. Furthermore, the colour of the fluorescence in different woods is different, ranging from snuff brown to violet with practically all shades of orange, yellow, green, blue and indigo, between these extremes. The intensity of the fluorescence, however, is not restricted to any particular part of the wood. In some cases, the heartwood fluoresces more brilliantly than the sapwood, and in others the reverse is the case. Then again, in many cases, the colour of the fluorescence in sapwood and heartwood is very different.

In making extracts of the wood powders (100-mesh) we have employed absolute alcohol, acetic acid, ethyl ether, chloroform and xylene. Of these, alcohol and acetic acid extracts showed fluorescence in almost

[4] Bary and others, *Natural and Synthetic Resins*, 118.

[5] *Wochenblatt f. fabrikation*, 1932, **63**, 103.

all those cases where the original wood fluoresces, while in the case of ether, chloroform and xylene extracts, only in a few cases was the fluorescence observed and that too very faintly. Results for some typical cases are recorded below :

Species		Wood Blocks		Powder		Extracts	
		Colour in Sunlight	Colour in Ultra-violet light	Colour in Sunlight	Colour in Ultra-violet light	Alcoholic in Ultra-violet light	Acetic in Ultra-violet light
Acacia arabica	S	YO (B.T.M.)	BV (B.T.L.)	OY_{T_2}	BV (B.T.L.)	VB_{T_2}	VB_{T_2}
	H	O (B.T.D.)	OY	VO (B.T.L.)	OY	YG	YG
Acacia catechu	S	OY_{T_2}	Y	Y_{T_2}	OY_{S_1}	BV (B.T.L.)	B (B.T.L.)
	H	O (B.T.D.)	OR (B.T.D.)	YO (B.T.L.)	R (B.T.D.)	YO (B.T.L.)	Y_{S_1}
Adina cordifolia	S	Y_{T_2}	Y_{T_1}	Y_{T_1}	Y	V_{S_2}	G_{S_1}
	H						
Albizzia lebbek,	S	WGr	B (B.T.L.)	WGr	B (B.T.L.)	BV_{T_1}	GY
A. procera & *A. stipulata.*	H	YO (B.T.D.)	OY	YO (B.T.M.)	YO	Y_{S_1}	GY_{T_1}
Cassia fistula	S	YO (B.T.L.)	YO_{S_2}	YO (B.T.L.)	Y (B.T.L.)	GY_{T_1}	Y_{S_1}
	H	OR (B.T.L.)	RV	YO_{T_2}	RV	RV_{T_2}	BV
Cedrela toona	S	YO (B.T.L.)	Y (B.T.D.)	YO (B.T.L.)	Y (B.T.D.)	G_{T_1}	V (B.T.M.)
	H	O (B.T.D.)	O (B.T.D.)	O (B.T.D.)	O (B.T.D.)	OY_{S_1}	OY_{T_2}
Morus alba	S	WGr	V_{T_1}	WGr	RV_{T_1}	V_{T_1}	VB_{T_1}
	H	Y (B.T.L.)	V_{T_1}	OY_{S_1}	YO_{S_1}	BV_{T_1}	BV

Colour standard issued along with Mullekin's "*Identification of the Commercial Dye-stuff*," John Wiley & Sons, New York.

VR—Violet-red
OR—Orange-red
RO—Red-orange
YO—Yellow-orange
OY—Orange-yellow
GY—Green-yellow
YG—Yellow-green
BG—Blue-green
VB—Violet-blue
BV—Blue-violet
V—Violet
RV—Red-violet
WGr—Whitish-grey
S_1—Shade$_1$
T_1—Tone$_1$
B.T. Broken Tones
L. Light
M. Medium
D. Dark
S Sapwood
H Heartwood

Forest Research Institute,
Dehra Dun, U.P.,
July 24, 1934.

S. KRISHNA.
K. A. CHOWDHURY.

Crystal Structure of the Fluoberyllates.

RECENTLY N. N. Ray[1] has observed from solubilities, molecular volumes and formation of mixed crystals that the simple and complex fluoberyllates of metals are completely isomorphous with the corresponding sulphates. Goniometric and X-ray studies of these isomorphous crystals were accordingly undertaken for a thorough investigation.

From goniometric measurements, the fluoberyllates of potassium, rubidium, ammonium and thallium were found to belong to the orthorhombic bi-pyramidal class (V^h) to which the sulphates of these metals are also known to belong. The crystallographic axial ratios of these fluoberyllates, and those of the corresponding sulphates are given in Table I.

TABLE I.

Metallic radical	Fluoberyllates			Sulphates		
	a	*b*	*c*	*a*	*b*	*c*
Potassium	0·5744	1	0·7431	0·5727	1	0·7418
Rubidium	0·5766	1	0·7560	0·5723	1	0·7485
Ammonium	0·5665	1	0·7241	0·5635	1	0·7319
Thallium	0·5638	1	0·7368	0·5555	1	0·7328

[1] *Zeit. Anorg. U. Allg. Chem.*, 1931, **201**, 289.

The space group of potassium fluoberyllate was very carefully determined by oscillation photographs of ranges 10° in a camera of high resolution (the diameter being 17·2 cm.) and was found to be D_{2h} $p\mu\gamma\nu$ (*i.e.* V^{16}_{h} according to Schonflies notation). This is also the result of the most reliable determinations,[2] of the space group of potassium sulphate.

Rotation photographs of the crystals of rubidium, ammonium and thallium salts also show the same space-group. This independent determination also agrees with a very recent publication of the space group of ammonium fluoberyllate by Hultgren.[3] The axial lengths in Angstrom units of these crystals as measured from layer line photographs are given in Table II.

Determination of the positions of the atoms by measurements of intensities of X-ray reflections is in progress.

TABLE II.

Metallic radical	Fluoberyllates			Sulphates		
	a	*b*	*c*	*a*	*b*	*c*
Potassium	5·63	9·83	7·29	5·73	10·00	7·42
Rubidium	5·85	10·13	7·66	5·94	10·39	7·78
Ammonium	5·89	10·39	7·49	5·95	10·56	7·72
Thallium	5·87	10·43	7·68	..	..	..

N. N. Ray[4] also investigated the double fluoberyllates as well as several double salts of fluoberyllates with sulphates and he found all of these to be physically and chemically similar to the corresponding double sulphates. Goniometric studies revealed a crystallographic isomorphism between these two series also and showed that all these fluoberyllates belong to the class Monoclinic, Prismatic (C^{h}_{2}) with the following axial ratios and axial angles (β).

TABLE III.

Metallic radical	Double fluoberyllate $(BeF_4)_2$				Double sulphate $(SO_4)_2$			
	a	*b*	*c*	β	*a*	*b*	*c*	β
Am_2Zn	0·7387	1	0·4909	106° 34′	0·7368	1	0·4997	106° 52′
Am_2Co	0·7405	1	0·4852	106° 46′	0·7392	1	0·4985	106° 56′
Am_2Ni	0·7373	1	0·4914	106° 40′	0·7370	1	0·5032	107° 4′

Metallic radical	Sulphato fluoberyllate (SO_4BeF_4)				Double sulphate $(SO_4)_2$			
	a	*b*	*c*	β	*a*	*b*	*c*	β
Am_2Zn	0·7382	1	0·4942	106° 43′	0·7368	1	0·4997	106° 52′
K_2Ni	0·7405	1	0·5077	104° 44′	0·7379	1	0·5020	105° 0′

It is also intended to make a complete X-ray study of this interesting series of double salts.

P. L. MUKHERJEE.

Physics Laboratory,
Dacca University,
Ramna,
July 1934.

[2] Hermann and Ehrenberg, *Zeit. f. krist.*, 1929, **70**, 163.

[3] *Zeit. f. krist.*, 1934, **88**, Part III.

[4] *Zeit. Anorg. U. Allg. Chem.*, 1932, **206**, 209.

Antirachitic Factor in Kabuli Chhola Oil.

IN two of our previous communications, published in *Current Science*,[1] we referred to some important points regarding the presence of oil-soluble vitamin A in some pulses and fishes. A few physiological and spectrographic records were also published. In the present communication we reproduce two X-ray photographs.

Fig. 1 is that of a rat kept on rachitogenetic diet all through.

Fig. 2 was fed on rachitogenetic diet from the 7th February 1934 to the 5th March 1934.

From the 5th March, the rat No. 2 was given a daily dose of freshly prepared Kabuli Chhola Oil.

On the 17th March, under X-ray observation, a distinct indication in calcification was noted in rat No. 2.

X-ray photographs here reproduced were taken on the 5th April 1934.

There was a litter of eight rats born on the 5th January 1934. These eight rats formed the subject of the present investigation. All of them gave similar results under experimental conditions.

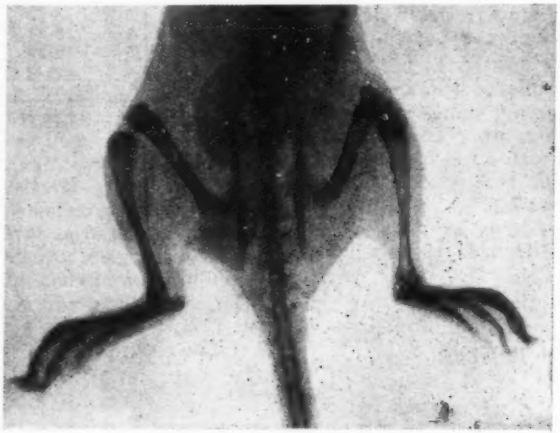

Fig. 1. Rachitic.

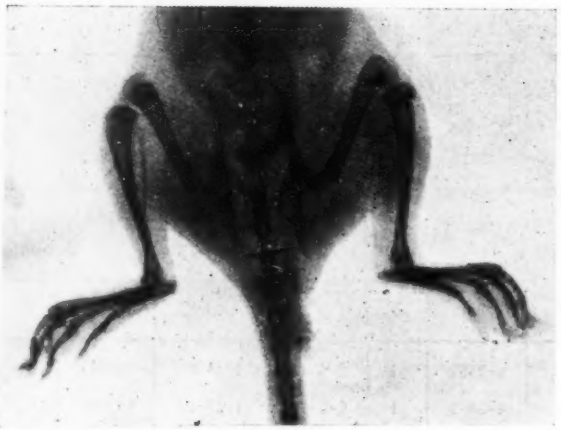

Fig. 2. X-ray Photograph after Kabuli Chhola Oil Feeding.

It may be mentioned that weight of bones, bone ash, calcium and phosphorus present in the ashes were also determined. The results all went to confirm the anti-rachitic quality of Kabuli Chhola Oil.

Bones of non-rachitic rats weighed considerably heavier than rachitic ones. Again the percentage of ash of *bones dried at 100°C.* was found to be as follows :—

Bone ash of non-rachitic rats 53·13.

Bone ash of fully rachitic rats 44·68.

Bone ash of partially cured rats 47·78.

Finally the Ca to P ratio were in the following order :—

Non-rachitic, 2·20; fully rachitic, 1·91; and Rickets cured (Rachitis cured), 2·06.

Other details as regards calorific value and comparative results obtained with different pulses will be published in the *Transactions of the Bose Research Institute.*

N. C. NAG.
H. N. BANERJEE.

Bose Institute, Calcutta,
July 30, 1934.

[1] Nag and Banerjee, *Curr. Sci.*, 1933, **2**, 3, 95.

Banerjee and Nag, *Curr. Sci.*, 1933, **2**, 4, 131—132.

A Conductometric Method for Moisture in Bagasse.

WHEN a definite quantity of moist bagasse is digested hot with a common salt solution of known electrical conductivity the distribution of the salt through the water in the bagasse results in a depression in the conductivity of the original solution and this depression will be a measure of the amount of moisture in the bagasse sample. It is essential to make an allowance for the conductance of the 'residual juice' and this should only be of lower magnitude compared to the conductance of the salt solution when accurate quantitative results are desired. The sugar chemist is already familiar with the digestion with plain water for determining the sucrose per cent. bagasse and it is only a small modification to use a salt solution instead and derive both the sucrose and moisture data in one experiment. The great advantage of this method is the elimination of the drying method which requires several weighings and separate samples for moisture and sucrose determinations. By employing the familiar Deerr digestion an unprepared and a large sample can be analysed. The simultaneous determination of both sucrose and moisture on one and the same sample results in a better derivation of the fibre figures especially where fibre per cent. cane is calculated indirectly. These advantages of the conductometric method more than set off the high cost of conductivity equipment the necessity of which is already being felt for making such determinations. One limitation of this method, however, is its applicability only for the final bagasse and when the common method of plain water inhibition is practised at the mills.

Experiments employing approximately normal solution of sodium chloride and about 500 gms. of bagasse in a Deerr digestion have given results which are in agreement within $1\frac{1}{2}\%$ with those obtained by drying to constant weight. The moisture content of the samples analysed lay between 40% and 50%. Some samples were deliberately dried partially and then analysed. The results were again satisfactory. All these analyses were done on preserved samples and their extracts were of as low a pH as 4·6 but nevertheless the method works and it should succeed under the better conditions prevailing during the routine factory analyses.

The conductance of the residual juice enters into the calculation only as a correction factor provided the brine solution is strong enough (at least uninormal) and an average value for this factor can be experimentally established once for all and applied always it being necessary to redetermine it only very occasionally. A better method is to correlate the conductance or even the brix of the 'last-expressed juice' with the 'residual juice' correction. Such a correlation between the composition of the 'last-expressed juice' and the 'residual juice' is already in practice while calculating the fibre per cent. bagasse.

A detailed paper on this new method of bagasse analysis will appear elsewhere.

G. GUNDU RAO.

Indian Institute of Science,
Bangalore,
August 7, 1934.

The Inactivating Effect of Ultraviolet Light on the Virus of Rabies.

CLIFTON (1931),[1] Perdrau and Todd (1933)[2] found that methylene blue had the photodynamic property of inactivating certain viruses: *e.g.*, Bacteriophage, Herpes, etc. Shortt and Brooks (1934)[3] found that this dye exercised a similar action on the Fixed Virus of Rabies in the presence of Sunlight. Galloway (1934),[4] almost simultaneously, made a similar observation, but was not able to confirm that of Shortt and Brooks' when using unfiltered suspensions of infective material. Since Shortt and Brooks used sunlight while the other observers used an electric filament or Pointolite lamp, it occurred to us that the success recorded by Shortt and Brooks was, perhaps, due to the action of ultraviolet rays of light. Accordingly, we repeated their experiments using a quartz mercury vapour lamp as the source of ultraviolet rays. We found that by this means we were able to inactivate a 0·5 per cent. centrifuged emulsion of Rabies-infected rabbit's brain (Fixed Virus)

[1] Clifton, C. E., *Proc. Soc. Exp. Biol. N. Y.*, 1931, **28**, 745.

[2] Perdrau and Todd, *Proc. Roy. Soc.*, 1933, **B 112**, 277 & 288.

[3] Shortt and Brooks, *Ind. Jour. Med. Res.*, 1934, **21**, 581.

[4] Galloway, I. A., *Brit. Jour. Exp. Path.*, 1934, **15**, 2, 97.

in as short a time as 60 seconds exposure to the ultraviolet rays of light. With shorter exposures, 15 and 30 seconds, the Virus appeared to be attenuated but not completely inactivated, since some animals inoculated with the brain emulsion irradiated for the shorter periods developed Rabies while the others did not; in the former the incubation period was somewhat prolonged. It was found, further, that inactivation was as complete in the absence of methylene blue as in its presence (dilution of 1 in 25,000). Irradiation with the quartz mercury vapour lamp had a similar effect on Street Virus Rabies. It then occurred to us that this method of inactivation of the Virus might be used instead of the carbolic acid method for the preparation of Rabies Vaccine; the advantage being that 30 days are required for its preparation by the latter method, while by the former a few days would suffice. The present-day Rabies Vaccine is a 5 per cent. emulsion of infected brains in normal saline solution. Accordingly, we irradiated a 5 per cent. emulsion of the brain of a rabbit that was infected with the Fixed Virus Rabies (Paris) for 15 minutes. The emulsion was inoculated subdurally into rabbits almost immediately afterwards. Two out of the three animals so inoculated subdurally died showing typical signs of Rabies. This we thought was due to the ultraviolet rays not having penetrated deep enough into the infected opaque emulsion. We, therefore, oscillated the shallow dish containing the emulsion while it was being irradiated for 20 minutes; by this means the ultraviolet light was enabled to reach the whole of the emulsion. The emulsion, so oscillated and irradiated, was found to be inactive on subdural inoculation into rabbits. These inoculations were carried out on the 6th of July and at the time of writing, one month later, the inoculated animals are alive and well.

Details of this work together with those of experiments designed to determine the antigenic property of ultraviolet irradiated Rabies Vaccine will be reported in the *Indian Journal of Medical Research* at a later date.

G. SANKARAN.
W. A. BEER.

Pasteur Institute,
Coonoor,
August 10, 1934.

Enteropneusta from Krusadai Island.

THE occurrence of Enteropneusta in the neighbourhood of Krusadai, South India, was first made known by F. H. Gravely and recently the members of the staff of the Zoology Department, Central College, have obtained a very large collection of these interesting forms. S. G. M. Ramanujam has also taken specimens from the same area but it is rather surprising that our collections do not include any of the specimens represented in Dr. Ramanujam's, which does not possess a single form contained in our material. But still both parties were investigating the same area and this rather curious phenomenon of distribution is worth carefully looking into.

I have examined the specimens contained in the two collections. Dr. Ramanujam's specimens are *Ptychodera minuta* and *Glandiceps hacksi* which have been reported from Madras coast by K. Ramunni Menon. The occurrence of these forms near Krusadai must be an interesting fact in their distribution. Among the specimens contained in our collection, there are two distinct species of the genus *Chlamydothorax*. It may be recalled that Spengel mentions in his monograph on Enteropneusta *Ptychodera ceylonica*, two specimens of which were obtained from the west coast of Ceylon. They were comparatively small and on an examination of the external morphology of the branchiogenital and liver regions, but without examining the internal anatomy he concluded that the Ceylon specimens were identical with *Pt. bahamensis:* the latter according to Spengel's suggested scheme of classification would rightly be regarded as *Ch. bahamensis*.

I have carefully examined the internal anatomy of the Krusadai forms and I have no hesitation in saying that there are two different species of *Chlamydothorax* contained in our collection. Spengel's specimens of *Chlamydothorax ceylonica* are not procurable from the University Museum of Giessen, or Berlin and none from Colombo Museum. It is unfortunate that Spengel did not leave on record a description of the internal anatomy of the Ceylonese Enteropneusta; the situation becomes further complicated if we add another Enteropneusta also insufficiently described, *viz.*, *Pt. tricollaris* (Schmarda) from Ceylon.

In examining my material, I have kept these two undescribed or partly described

forms before my mind and I have come to the conclusion that Spengel's *Ch. ceylonica* is entirely different from *Ch. bahamensis*: and Schmarda's *Pt. tricollaris* is the adult specimen of *Ch. ceylonica*. In the paper which I am preparing for publication, I retain *Ch. ceylonica* as a distinct species in which case *Pt. tricollaris* should be treated as its synonym. The second species represented in our collection will be described as *Ch. kusadiensis*. I have assigned one of these forms to Spengel's species, *Ch. ceylonica*, purely on the presumptive basis that this might have been Spengel and Schmarda's forms, and yet it might happen that this species was not known to these authors.

Central College, Bangalore, *August 8, 1934.* C. R. NARAYAN RAO.

Balaenoptera indica, Blyth.

MR. MCCANN'S note on the great Indian fin-whale published in *Current Science*[1] is interesting and obviously the writer is of opinion that this large whale deserves the rank of a separate species assigned to it by Blyth. Blanford[2] is not quite sure about the position of the great Indian whale, for he observes that "as already pointed out, this species is probably the same as the great northern fin-whale (*B. sibbaldi*). Beddard[3] writing on the distribution of Balænoptera points out that there seem to be no substantial grounds for retaining such species as *B. indica*, *B. patachonica*, *B. schlegelii*, etc." Blyth[4] relies on the comparative slenderness of the mandible of the Indian forms of the great fin-whale for elevating them to the rank of a distinct species: a specimen said to be 84 feet long, had a lower jaw measuring only 21 feet. Collett[5] has mentioned that specimens of *B. sibbaldi*, measuring 80–90 feet long, have lower jaw bones two-ninths of the total length and for a specimen 90 feet long Collett gives 20 feet as the length of the mandibles. Mr. McCann's measurement of the mandible of the specimen recently stranded in Bombay is in accordance with the above figures. In the absence of definite knowledge of the other external and internal characteristics of the Indian forms, it is risky to maintain that they constitute distinct members separable from *B. sibbaldi*. The occurrence of these whales in the tropical seas during summer which, according to the migration theory, should be found in the colder latitudes at the time, is no doubt a strong point, but will not constitute a character for creating a separate species.

Central College, Bangalore, *August 8, 1934.* B. R. SESHACHAR.

The Silk Industry of Japan.

By N. Rama Rao,
Rtd. Director of Industries and Commerce in Mysore.

MR. C. C. GHOSH'S monograph on the Silk Industry of Japan (Scientific Monograph No. 8 of the Imperial Council of Agricultural Research) is what a publication of this kind should be—a study by a competent sericulturist of the Silk Industry of the premier sericultural country of the world. Such a study is sure to have been conducted with insight, and with a mind keenly alert to educative value. The publication comes with dramatic fitness at a time when the Tariff Board enquiry has drawn attention to the importance of the Indian Silk Industry; and the grant of protection, albeit inadequate, for Indian Silk by the Government of India has imposed on Silk-producing Provinces and States the duty of developing their sericulture in fulfilment of their implied promise to the Indian weaver and the Indian consumer.

The organisation in Japan has evolved as the result of a purposeful policy working towards a clearly conceived objective. Japanese sericulture is an important expression of Japanese patriotism, and nothing is more striking than the way in which the whole country, from the farmer to the Imperial family, has worked together for the

[1] *Curr. Sci.*, 1934, **3**, 1.

[2] *Fauna of British India—Mammalia, 1881-91*, 568.

[3] *A Book of Whales*, 159.

[4] *Journ. As. Soc. Bengal*, 1859, **28**, 488.

[5] *Proc. Zool. Soc.*, 1886, 253 and *Fauna Brit. Ind. Mamm., 1888-91*, 567.

improvement of Japan's most important industry.

In the silk-producing parts of India natural conditions are quite as favourable as in Japan to the growth of the industry. The present reviewer, speaking with intimate knowledge of Mysore, can say without fear of informed contradiction, that this State enjoys exceptional advantages in climate and economic environment, and offers a practically unlimited scope for the expansion of sericulture. This was the opinion also of Italian and Japanese experts who visited Mysore, and went over the silk-producing tracts, with an eye to business. In Mysore, the industry is essentially connected with welfare. To quote the memorandum submitted to the Tariff Board:

"The industry is of great economic importance to the State. In some form or other it provides employment to about two lakhs of families.... nearly a sixth of the total population. In the rural economy sericulture plays a very important part.... enabling the family to turn its waste time to account and earn a return which in many cases makes all the difference between a half-starved and hopeless life, and a self-respecting competence."

This can probably be said with equal truth of other parts of India. The Governments of silk-producing states and provinces could not do better than follow in the footsteps of Japan in regard to their Sericulture.

The most striking features of the Japanese organisation are its comprehensiveness of scope, and the manner in which the assistance of the State reaches out into its most minute ramifications providing here a framework, there a suggestion test or scrutiny, elsewhere a gesture or more substantial token of approval or recognition. This immanence, so to speak, of watchful solicitude is calculated to inspire the worker with confidence, and make him respond nobly. From the cultivation of mulberry onwards every process is being constantly watched, tested, improved and standardised with unflagging vigilance. The Government not only desires the maximum of industrial efficiency; it is most anxious to maintain the reputation of Japanese silk for quality in the world's markets. There is no doubt that the success of Japanese sericulture is due to sustained scientific research, the results of which are promptly transformed into industrial practice by an admirable organisation which reaches the farmers, and to a careful study of markets made with a desire to supply them with acceptable goods. As Mr. Ghosh says:—

"The secret of Japan's success in foreign markets is (*a*) close and continued study of the requirements of these markets by special representatives, and (*b*) standardisation."

Of course, standardisation means careful supervision and scrutiny and a rigid enforcement of standards by conditioning house tests and what is even more effectual, by the enlightened public opinion within the industry itself.

In Japan, standardisation is possible in the aggregate, because it is possible in every section of the industry. There is a distinct organisation for each part, which is so developed as to afford scope for specialisation in that part. It is difficult to conceive of an arrangement more conducive to rapid practical progress. For instance, the preparation of mulberry grafts—for in Japan there is no promiscuous propagation from seeds and cuttings—is a specialised industry giving employment to about 200,000 workers. The admirably organised and controlled system of egg-manufacture supplies the huge requirements of the industry with disease-free hybrid eggs, carefully selected and crossed according to the needs of each locality. This system furnishes employment to 8,000 establishments of scientific workers.

The rearing is done under the supervision and guidance of experts engaged on a co-operative basis for the season, and this has called into being a class of people who have to develop practical usefulness to earn a living. Then there are organisations for stifling cocoons, selling them, and so on and so forth, till the cocoons get to the reeling establishments, small and great, ranging from a girl with a *charka* to filatures with thousands of basins and workers "In 1927, the reeling factories 83,568 in number employed 462,594 women and 33,335 men." In Japan it took 30 years to revolutionise reeling and raise it from a state not very unlike ours to its present world-renowned quality. About 90% of Japan's silk is now reeled in filatures.

Though the bulk of Japan's raw silk is exported, there is enough left to support a flourishing weaving industry. Japan has a considerable export in silk goods, thanks to the excellent organisation of weaving with the help of domestic looms and cheap electric power.

The monograph is so interesting and so packed with facts, that to quote is a temptation fraught with danger; but no apology is perhaps necessary for two short extracts on two matters of supreme importance to Indian sericulture—especially Mysore and Kollegal sericulture—namely, seed production and sale of cocoons. It is obvious that a defect in either will rob the farmer of the fruits of his labour.

In Japan "Rearers of silk-worms are prohibited by law from producing eggs for rearing. The Imperial Sericultural Experimental Station is engaged on testing silk-worms from all over the world, and selecting suitable ones for Japan. It recommended for rearing the F_1 crosses of certain races. These races are made available to the Prefectural Experimental Stations which test them for .....local conditions. The parent worms are reared in the Prefectural Experimental Stations and made available to licensed seed-producers for producing F_1 cross for the general rearer.....There are 8,000 licensed egg-producers, and more than 40,000 persons engaged in the sale of these eggs."

Perhaps the most notable achievement of the Sericultural Department in Mysore has been in this direction. Races of worms from all over the world have been tested, and crosses selected such as would result in an increase of 40% in the return to the rearer. What is even more important is that the rearer, that most conservative member of a conservative race, has been educated to recognise and accept the improvement. But for want of sufficient grants from the Government, the industry has been denied anything like appreciable benefit from this great achievement.

Again in regard to sale of cocoons:

"The recent development is sale through co-operative drying societies. Government is encouraging and subsidising these in order to foster the trade in dried cocoons."

This is a measure well worthy of adoption in all parts of India, except Kashmir where silk is a state monopoly.

The monograph is so economical in words that further condensation would probably result in unintelligibility, and we shall, therefore, commend a study of the text itself to such of our readers as require more information than can be expected in a review. The high message of Japan to India is seriousness and a realisation that the human value of industrial research lies in the speedy incorporation of its results in industrial practice. Else, knowledge comes, but wisdom lingers. The example of Japan should teach us how knowledge and wisdom can march hand to hand to prosperity.

Research Notes.

A Cathode Ray Furnace.

THE cathode rays produced in a rarified medium by a high tension current heat up very strongly any body (anti-cathode) placed in their path. This has been used by different experimenters to realise very high temperatures. Crookes (1879) was the first to make use of such an arrangement to melt platinum. In a recent paper in *Bull. Soc. Chem. de France*, Feb. 1934, p. 262, M. F. Trombe has described with details another cathode ray furnace worked by a transformer 110 to 20,000 volts, and utilising a current of 100 m.a. at the high tension. It consists essentially of a quartz bulb of three litres capacity into which are ground the aluminium electrodes—cooled by a current of water—and the support for the anti-cathode. A plane window placed near the tungsten anti-cathode crucible makes it easy to observe and measure optically the temperature realised. The apparatus is characterised by a regularity in functioning, and the temperature reaches to 2700°C. in 15 to 20 seconds.

M. A. G.

On a New Mass-Spectrograph.

IN the *Zeitschrift für Physik* (1934, **89**, 786), J. Mattauch and R. Herzog describe a new form of mass-spectrograph and the advantages it possesses over the forms used by Aston and Dempster. The focussing method of Aston utilises the prism-like action of the deviating fields so that ions of different velocity but same mass come together to a focus, when the initial direction of all the rays is the same. In the method of Dempster the lens-like action of a magnetic field is used to focus ions of the same velocity but issuing in different directions so that they come together. Now R. Herzog has

shown that a radial electric field or a homogeneous magnetic field act as a combination of a prism and a cylindrical lens (*Zs. f. Phys.*, 1934, **89**, 447). Hence if a canal ray containing particles of various masses and velocities is compared to white light, a combination of two such lenses should make it possible to obtain an achromatic image of the slit, *i.e.*, one focus for particles of the same mass but different velocities and directions. The authors now describe a form of mass-spectrograph which makes it possible to realise such a focussing. The canal rays proceeding in all directions from a slit are subjected to the action of a radial electric field and then to a homogeneous magnetic field in such a way that rays passing out in different directions and also containing particles of various velocities are brought to a focus at a single point. For special values of the angle of deviation by the electric field, the foci corresponding to particles of different mass lie on a straight line as in Aston's instrument. The form of pole-pieces is calculated in the paper. The advantages claimed for the new form of mass-spectrograph are the following:

(1) Since there is a focussing both with regard to directions and to velocities collimation by means of two narrow slits is not necessary and the canal ray beam will be more intense and the accuracy of measurement will be increased.

(2) Besides the greater sharpness and intensity of the lines, the resolving power for apparatus of similar dimensions is ten times as large as in the case of Aston's instrument.

(3) The mass-scale is simpler and easier to calculate than in the case of Aston's spectrograph. The distances of the lines from a fixed point are proportional to the square roots of the masses.

(4) The resolving power is the same all along the line of foci and for all masses.

(5) The angle at which the rays meet the photographic plate is the same for all masses and is much larger than in Aston's instrument.

(6) Since the angle of deviation by the magnetic field is only half as large as in the apparatus of Dempster or Bainbridge where it is 180° the strength of the magnetic field need not be so large.

The results obtainable with such an instrument would be interesting if all the conditions are realised in practice.

On Demonstrations with very short Sound Waves and the Reaction of a Sound-Wave Field on the Source.

IN the *Physikalische Zeitschrift*, (1934, **35**, 524), E. Meier describes improved apparatus for demonstrating the properties of a field of very short sound waves. In order to increase the intensity of the radiation, a parabolic reflector having a depth equal to twice the focal length was used, so that more than half the energy of the source was converted into a parallel bundle. The reflectors were made of brass plate 1 mm. thick and had a diameter of 50 cm. When a grating made of two or six slits in a plate covered the opening of the reflector and the whole apparatus was rotated, the audience at successive positions could hear the sound when the diffraction maxima fell in their direction. For an objective demonstration sensitive flames were used. The flame was usually at the focus of a cylindrical parabolic mirror which served also to screen the flame from other influences. Useful forms of the burner for producing the sensitive flame are described. A brass tube of 8 mm. internal diameter tapers conically to a diameter of 2 mm. in a length of 40 mm. and the total length of the tube is about 100 mm. Such a burner is not too sensitive and is well suited for an auditorium. The shape of Galton-whistle was also modified to obtain a series of plane wave-fronts. The article contains a figure showing the new form. During the course of experiments with the apparatus described, it was found that a plane reflector placed at right angles to the parallel beam from the parabolic reflector influenced the state of vibration of the source. When the reflector was moved to and fro in front of a whistle served with a strong blast, the sound of the latter waxed and waned. In the case of a weaker blast some positions of the reflector could be found at which the whistle was completely silenced. If the ear is placed near the whistle one only hears a siffling of the escaping wind but no sound. The corresponding positions of the reflector are situated at intervals of $\lambda/2$. It appears as if the reflected wave interferes destructively with the vibrations of the air coming from the source. With a very weak whistle it was also possible to find positions of the reflector midway between the positions above described so that the sound was enhanced.

Geochemistry of Living Matter.

THE progress achieved in Prof. Vernadsky's laboratory devoted to the study of biogeochemical problems, forms the text of a contribution by Uvarov published in a recent issue of *Nature* (1934, **134**, 11). A special laboratory devoted to the investigation of the geochemical rôle of organisms was created by the Russian Academy of Sciences in 1928, and in the short period of its existence, a number of valuable results have accumulated from the labours of Prof. Vernadsky and his collaborators.

The quantitative investigation of the chemical composition of living organisms has shown that certain organisms function as accumulators of definite elements; thus ants accumulate manganese and Lycopodiaceæ accumulate aluminium. The organisms which are geologically ancient possess the ability to concentrate a very wide range of elements. Vinogradov has, by means of a graph, demonstrated that every sixth element in the periodic table is of special significance to organisms.

Another important problem studied in the laboratory is the atomic weights of elements obtained from living organisms. The hypothesis propounded by Vernadsky in 1926, that living organisms possess selective powers in utilising isotopes of the elements, has been experimentally verified by Loving and Druce, who have shown that in potato, the isotope 41 of potassium predominates. In ordinary potassium, the chief isotope is of atomic weight 39.

These and several other problems relevant to the fundamental conception that living matter is a factor in the history of the earth, are being investigated in the laboratory under the inspired leadership of Prof. V. I. Vernadsky and important results which would establish closer relationship between the organic and inorganic worlds are awaited.

Vitamin C and Amylases.

ON account of their relation to carbohydrate metabolism, Vitamin C and Amylase are both important in cancer research. The influence of Vitamin C (Ascorbic acid) on amylases forms the subject-matter of an important communication by Purr (*Biochem. J.*, 1934, **28**, 1141) from the Cancer Research Laboratory, Pennsylvania.

From a study of the effect on various animal amylases, Purr concludes that ascorbic acid possesses a specific activating influence on β-amylase at the optimum pH 6·8. The activation is linked with an increase in the transition point and in this respect is sharply differentiated from the activation by calcium salts and amino acids, where the transition is hastened but not affected. The activation of calcium salts and amino acids is observed only at a higher acidity (pH 5·1).

The effect of ascorbic acid on plant amylases is altogether different; an inhibition is observed in all cases. Plant β-amylases are strongly inhibited by reduced ascorbic acid but unaffected by the oxidised form, while in the case of α-amylases, the activity is inhibited by the oxidised form but unaltered by the reduced form of ascorbic acid.

The author further observed that in the ripening grains—barley, rye, or oats—the α-amylase is progressively inactivated, and this is probably related to the gradual decrease in Vitamin C observed by Virtanen and collaborators, during ripening.

The Beech Bark Disease.

THIS serious disease, which has been known to exist in Europe since 1849, has, within the last fifteen years, been noticed to spread steadily and to cause extensive mortality among the beech trees in N. America and Canada. A disease survey, by Ehrlich (*Canadian J. Res.*, 1934, **10**, 593–692) who investigated this disease in Canada, showed that in two areas as much as 50% of the trees had been killed, and 90% of the stands infected. The external symptoms of the disease are manifested by the gradual drying up of the foliage and twigs, the loosening of the bark in patches, and the ultimate death of the trees.

The disease has always been associated with the appearance on the bark of a scale insect *Cryptococcus fagi* (Baer), which, by feeding, injures the underlying tissues of cortex and the phloem. The fissures thus caused, provide an entry for the fungus Nectria, which gradually invades the Phelloderm, Cortex, Phloem and Cambium. This sequential attack by the insect and the fungus which was long ago indicated by Boodle and Dallimore and later by Rhumbler, has now been definitely established by Ehrlich by inoculation experiments. Morphological and cultural studies of the fungus are described, and data given

on the height of ascospore discharge which takes place after rain. Neither the insect nor the fungus by itself when placed on the bark was able to produce the disease symptoms on the tree. Inoculations with the fungus on mechanically wounded or Cryptococcus infested bark always produced infection.

The fungus causing the American disease has been identified by Wollenweber as *Nectria coccinea* (Pers) Fries while the European species has been reported to be *N. ditissima* Tul.

The disease can be controlled on ornamental trees by the application of insecticides such as Carbolineum-Sunoco oil, or Kerosene-soap emulsion. In the forests, removal of dying and dead trees and the possibility of biological control are indicated as remedial measures. Growing of beech on broad ridge tops rather than on steep slopes, and early introduction of young supplies in place of old trees, are likely, in the opinion of the author, to mitigate the ravages of the disease.

M. J. NARASIMHAN.

Biological Effects of Heavy Water.

E. NEWTON HARVEY has critically examined the results of previous workers on the effects of heavy water on animals and plants (*Biol. Bull.*, 1934, **66**, 2). It has generally been known that heavy water has deleterious effects on the growth of micro-organisms but the cause of this action is not known. It is observed that heavy water has no effect on the luminosity of *dried cypridina*, nor on fresh-water luminous bacteria but diminishes the luminiscence and retards the growth of marine bacteria. Protozoans and rotifers are seen to become gradually slow in their activity resulting in death but *Euglena*, though affected by heavy water, recovers after favourable conditions are restored. A tentative theory has been advanced that the deleterious effects of heavy water are probably due to the accumulation of hydrogen peroxide.

Chromosomes of Grasshoppers.

T. RAMACHANDRA RAO describes the structure and the behaviour of chromosomes in the spermatogonia of *Aularches* in a recent contribution (*Proc. Ind. Acad. Sci.*, 1934, **1**, 1). Aularches is a Pyrgomorphine grasshopper and possesses 19 telomitic rod-shaped chromosomes. During the several stages in the mitotic cycle they offer strong evidences for the chromonema theory as recently developed by certain plant cytologists. During the telophase processes the chromosomes gradually form vesicles, which show the presence of two thin intertwining chromonemata embedded in a lighter matrix. This observation also confirms the views of Robertson and McClung on the occurrence of telophase splits in Orthopteran chromosomes. The two threads gradually become very thin and finally pass beyond the limit of visibility. The interphase vesicles are quite independent of each other and during the prophase the characteristic spirals arise entirely within the limits of their own vesicles. The sex-chromosome offers striking pictures during the telophase when it is the first to diffuse and during the prophase when it is the last to re-condense.

On the Morphology of the Epipubis, the Nobelian Bones and the Phallic Organ of *Ascaphus Truei* Stejneger.

PROF. C. G. S. DE VILLIERS in an interesting paper (*Anat. Anz.*, 1934, **78**) describes some of the hitherto obscure points in the morphology of *Ascaphus*. The sub-pelvic skeletal rods which were supposed to be cartilaginous are now shown to be bony; these Nobelian bones are not cartilaginous derivatives. The prepubic skeletal element is cartilaginous and finds a homologue in the epsiloid process of urodeles or the epipubis of *Xenopus*. In two other animals the presence of epipubis has been noticed, *Ascaphus* and *Liopelma*. The musculature and vascularization are described.

Depth of Oil.

IN a recent number of the *Oil Weekly* (1933, **71**, No. 2), R. A. Jones has tried to answer the question 'How deep may Oil exist in the earth's crust?' For doing this he points out how necessary it is to know the depth to which porosity extends and proof of the existence of suitable rocks at that depth. In the light of the generally accepted geological estimates of the maximum thickness of sedimentary rocks, the author advances the idea that petroleum may occur in certain basins at depths of 20,000 to 30,000 feet below the surface.

Plagioclase Determination.

R. C. EMMONS of the University of Wisconsin has published a very important paper on 'Plagioclase Determination by the Modified Universal Stage' in the latest number of the *American Mineralogist* (June 1934, **19**, No. 6). The paper describes a modification of Federov's Universal Stage which both simplifies and speeds up the procedure for the determination of plagioclase felspars and their twin laws. The actual technique of this work is explained in detail and amply illustrated in the paper. It is also suggested that the same procedure may be extended to an intensive examination of all minerals in which optic orientation is a good diagnostic criterion.

Marchese Marconi.

(Born 1874.)

IN the history of engineering endeavour of recent times, the name of no worker is so widely known as that of the distinguished Italian whose sixtieth birthday on April 25th was the occasion for tributes from every part of the globe wherever radio communication and broadcasting affects the daily life of the community. In contrast to those among scientists who insist that the pursuit of science is a form of self-expression and therefore an end in itself, Marconi has steadfastly adhered to the view that all scientific work has for its fundamental aim the promotion of human welfare and prosperity. His is the unswerving devotion of a life-time to the pursuit of the great objective of developing radio methods for the communication of intelligence between men and nations the world over. If his field of activity has been a small patch in the vast expanse of scientific and engineering endeavour, he has, nevertheless, been an intensive worker and a remarkably successful one. With the vision and courage of the pioneer, Marconi has worked persistently at his ideas undismayed by the scepticism of contemporary scientists and undeterred by the inevitable obstacles of vested interests.

His contributions to the development of radio communication are remarkably impressive in both volume and quality. They began in 1895 in early youth with his experiments in his father's garden, at a time when hertzien waves were yet a newly discovered scientific toy of the laboratory. But after Marconi entered the field, each year saw an increase in the distance bridged across, culminating in communication across the English Channel in 1895 and the wonderful and spectacular success two years later in bridging the Atlantic between Cornwall and Newfoundland. That great achievement of Marconi formed the starting point for the gigantic progress of the later years in the spread of world-wide radio communication, in which Marconi and his famous company have played so great and distinguished a part.

We owe him the earthed antenna, the improved and extensive use of the principle of tuning, the use of parabolic reflectors for directional working, and many others. The world does not now remember the rôle played by Marconi's improved coherers, his magnetic detector, the disc discharger, the timed spark and so on. Subsequent to the advent of that wonderfully versatile engineering instrument, the thermionic vacuum tube, Marconi and his able engineers have been responsible for the conception, development and inauguration of the first short wave directive system of radio telephony and telegraphy, which by its spectacular success has revolutionised long distance radio communication over the earth.

At sixty, Marconi is still active and has obtained during the last few years, interesting results in the use of extremely short waves of the order of a small fraction of a metre. It falls to the lot of few men to contribute so greatly to the growth of a world industry of such fundamental importance and to witness its phenomenal growth from a mere scientific toy to a dominating influence in the daily life of the world within the short period of four decades in their lives.

If honours from governments, honorary degrees from universities, membership of learned bodies in different lands and prizes and medals are any indication of a man's worth, Marconi has them in abundant measure. The Mussolini regime has elevated him to a hereditary Italian marquis, and he is the first president of the newly formed Italian National Academy, the highest

scientific body in Italy. Great Britain has given him sympathy and encouragement in his work in generous measure and on her hospitable soil Marconi achieved many of his striking successes; the Government of Great Britain created him a G.C.V.O. Equally abundant is the measure of publicity that his work and movements obtain in the popular press of many lands.

The increasing activities and prosperity of his company and its associates are alone sufficient to justify the hope that the years to come will witness further additions to his notable achievements and the wider spread of his fame as one who by his work as scientist and engineer has served humanity truly and well.

R. E.

Molecular Spectra.

A SYMPOSIUM on the subject of "Molecular Spectra" was held in the chemistry hall of the Indian Institute of Science. All contributions to the symposium were received in full in advance, prominent among them being those from Prof. R. Samuel of Aligarh, Prof. Venkatesachar of Bangalore, Prof. K. S. Krishnan of Calcutta, Dr. Ganesan of Nagpur, etc.

In presenting his paper on "The Raman Spectra of Selenates and Selenic Acid", *Dr. Ganesan* discussed the dynamics of the AX_4 model representing the SeO_4-ion. In the state of solution the lines observed were 342, 415, 835 and 875, while for the crystalline state the same lines occurred sharper but with slightly displaced frequencies. From the data for the solution state and applying Dennison's formulas, the force constants for Se—O and O—O were calculated as 4·72 and 0·59 respectively. The heat of dissociation for Se—O was found to be 86 K. cal. while the corresponding value calculated from thermo-chemical and band spectra data came out as 95 K. cal. The spectrum of selenic acid differed from that of selenates, just as in the case of sulphuric acid and sulphates, there being a greater number of lines which relate now to the molecule H_2SeO_4.

An interesting discussion followed: *Prof R. Samuel* pointed out that the heat of dissociation cannot be entirely calculated from the Raman frequency alone, but a factor of anharmonicity in the vibrations must also be considered. The Raman effect at higher temperatures should show the presence of such an anharmonic factor. He also wanted to know whether there was any evidence for the existence of different kinds of Se—O linkages. *Dr. Krishnan* suggested that some of the discrepancies between the two dissociation values might disappear if due corrections were applied for the ionisation energy, etc., in the calculation of the thermal dissociation energy. *Prof. C. V. Raman* opined that the existence of only four lines indicated that the four bonds Se—O were identical, perhaps in particular for such slow infra-red oscillations. He referred to some earlier investigation by Bhagavantam on the Raman effect of benzene and carbon disulphide at higher temperatures, where no definite results were obtained. The lines should broaden out and any small shifts in the frequency will be particularly informative. *Prof. Venkatesachar* pointed out that he and Sibaiya had observed a shift of the centre of gravity of Raman bands to one side with rise in temperature. *Dr. P. Krishnamurti* remarked how the SeO_4 lines occur as two pairs, while the SO_4 lines are uniformly spread out. This is due to the heavier Se atom, and the phenomenon is similar in character to that observed with the heavier tetrachlorides as $SiCl_4$ and $TiCl_4$.

Dr. K. R. Ramanathan and *Dr. L. A. Ramdas* then presented a paper on the further extension of the ultra-violet spectrum of the sun. The present limitations due to the ultra-violet absorption band of ozone and of oxygen were analysed in detail, and it was shown that the heights accessible with pilot balloons must be sufficient for the object in view. Accounts of the spectroscopic methods of estimating the amount of ozone present in the atmosphere, and of calculating the height of ozone layer were also given.

A keen discussion followed in which *Prof. Raman* emphasised that generally in fitting a dispersion formula, the possible existence of bands in the extreme ultra-violet should never be neglected. *Dr. Ramdas* referred to the methods of determining the temperature of the ozone layer as being about 500°. *Dr. Ramanathan* in concluding the discussion complained that most reports about absorption spectra did not include sufficient details such as vapour pressure, temperature, etc., required to estimate the amount of substance employed, and consequently the published results could not be used for meteorological purposes.

Prof. R. Samuel presented a lucid account of the present state of knowledge regarding band spectra in general, and explained how a complete analysis of band spectra of diatomic molecules with the help of Franck-Condon diagrams, gives values of the dissociation energy in both the excited and unexcited states, and the harmonic and the anharmonic factors of inter-atomic forces. The anomalous cases where the energy of dissociation increases with the excitation state, and indeed so that the molecule in its ground state might consist of excited atoms, correspond to molecules with free valencies: the usual normal cases correspond to saturated compounds. The dissociation of molecules and their absorption spectra were then discussed and illustrated with the cases of I_2, CO, CO_2 and the silver halides, and it was particularly shown how AgCl in the vapour state must be a co-valent molecule, and not made up of ions like HCl. The absorption spectra of the alkali halides and of BeO and ZnO and the anomalous cases with free electron valencies such as NO, CaF, CdF, were described in detail, with their Franck-Condon diagrams. It was postulated in this connection that in crystals also, there are co-valent links between

molecules, and that such a postulate will explain the high melting point, etc.

The spectra of many triatomic molecules such as cadmium, zinc and mercury halides show continuous absorption. The atoms here are co-valently bound, while in $PbCl_2$ they can be shown to be electrovalently bound. The spectra of SO_3, P_2S_5, PCl_3, Cl_2O, SCl_2 were then described. They could be divided into two groups, the one such as SO_3, and PCl_5 in which the optical dissociation energy, D_o is equal to the thermal value D_T, while in the other, such as PCl_3, D_o is greater than D_T.

The vapours of organic molecules such as CS_2 show the phenomenon of predissociation. In CH_3Cl and other alkyl chlorides, the continuous spectrum is independent of the alkyl chloride, but the band spectrum differs from case to case, and should therefore correspond to the c—x link. The calculated frequency for the link in the excited state is 1090, the corresponding Raman frequency for the unexcited state being 1210. From the spectra of ethylene dibromide, there is evidence for the interaction between the two C—Br linkages. After a brief account of the absorption spectra of organo-metallic compounds the speaker discussed the interesting results obtained with molecules in the state of solution. Here in many cases as with zinc iodide in alcohol the type of binding gradually shifts from co-valent to electro-valent with increasing dilutions presumably due to the influence of the dipole field of the solvent molecules. When other salts are added to the solution the positive or negative ions thus introduced cause characteristic shifts in the band maxima. The influence of the foreign ion can be either of the nature of a Stark effect or of a change in the internuclear distance.

The theory of complex salts was next considered and it was argued that there could be no co-ordinate linkages here, but only the usual type of co-valent links. There can be no octet rule in general, and all the phenomena of valence can be explained on the basis of different grades of the same kind of linkage, *viz.*, co-valent. There can be no single electron link, and the supposed co-ordinate link formed by the lone pair of electrons in the nitrogen atom is not possible, as these electrons are both of 2s type, and with a neutralised spin.

A brief discussion ensued, in which *Dr. Govinda Rau* pointed out that the evidences for the existence of co-ordinate links were quite considerable. The low dipole moment of CO, and the fact that $Ni(CO)_4$ had no moment pointed to the existence of a co-ordinate link between C and O, in addition to the ordinary double bond. With a few more questions by *Prof. Venkatesachar*, *Dr. Krishnan*, and others, the discussion was terminated.

Dr. K. S. Krishnan then presented an account of the extremely interesting results that he has obtained in collaboration with *Mr. Seshan* on the absorption spectra and fluorescence in single crystals of several organic substances containing a number of benzene nuclei and in potassium nitrate containing the flat NO_3-ion. The absorption in the two planes parallel and perpendicular to the flat molecules showed characteristic differences. This suggests that the quantum efficiency of photo-dissociation in such crystals may depend upon the polarisation of the light employed. A particularly interesting finding was that traces of impurities such as napthacene in diphenyl were also oriented in the crystal, and their presence was clearly brought out in the analysis.

Mr. T. S. Subbaraya reviewed the present position of our knowledge of the band spectrum of mercury and gave the results of a new vibrational analysis of five of the band systems which removed the discrepancies between the results of different investigators. A rather unusual fact pointed out by the author was that vibrational levels with vibration quanta which at first increased and then converged to zero were found in the common ground level of these bands which is accepted to be a $(^1S_o+^1S_o)$ state; the other results were, however, shown to be in accordance with theoretical expectations. Since a stable molecule with a strong binding was not to be expected in the case of van der Waals forces alone, the explanation of the levels revealed by the new analysis was to be the subject of further investigation.

In the discussion that followed *Dr. Samuel* remarked that since it is difficult to accept that the $(^1S_o+^1S_o)$ state could possess such vibrational states as those discovered by the author, one might possibly get over the difficulty by assuming the ground state to be a $(^3P+^1S_o)$ state and the others to be also $(^3P+^3P)$ states. *Mr. Subbaraya* replied that even here there would be difficulties since mercury vapour is known to be monatomic.

Mr. Nagendranath gave an account of the refined methods that he has developed for calculating the frequencies of tri-, tetra- and other poly-atomic molecules.

Dr. M. A. Govinda Rau then presented a paper on the comparative study of the Raman spectra of benzene and pyridine and the conclusions that could be drawn regarding the frequencies and modes of vibration of the benzene molecule. The trigonal symmetry of the benzene molecule was emphasised, and it was shown that the Kekule dynamic model for benzene was strongly supported by Raman spectra data. In a discussion that followed *Prof. Raman* and *Mr. Nagendranath* showed the mathematical difficulties in accepting these interpretations which are so widely supported by Kohlrausch and several others.

Mr. S. Kulkarni Jatkar gave an account of his experimental work on the Raman spectra of several organic compounds, and the elaborate precautions taken with regard to the purity of the substances employed such as cyclohexane.

Other papers presented to the symposium were taken as read. *Sir C. V. Raman* in winding up the symposium thanked the several contributors and those who took part in the discussions, and referred in particular to Prof. R. Samuel whose enthusiastic co-operation in the proceedings made the symposium such a great success. It was also announced that all the papers presented in the symposium would be very soon published in the form of a monograph.

M. A. G.

Micro-Climatology in relation to Crops.*

By R. J. Kalamkar.

(Agricultural Meteorology Branch, Poona.)

IN a recent note[1] the importance and scope of micro-climatological studies were discussed. The present note is a continuation of the above with special reference to conditions inside crops as compared to those in the 'open'.

INFLUENCE OF VEGETATION ON MICRO-CLIMATE.

Not only does the climate of a place determine what crops or vegetation would thrive there but also the latter in their turn modify the climate and in particular the "micro-climate".

The influence of plants on "micro-climate" would depend upon the nature of plant surfaces, the convective processes in the neighbourhood of plants and the height and density of vegetation.

A surface of vegetation greatly alters the thermal conditions of the earth. Plant surfaces absorb solar radiation. A part of the absorbed energy is utilised in transpiration and photosynthesis while the rest of the energy goes to increase the temperature of the plant material which also loses part of the energy by emission of thermal radiation. Transpiration and evaporation from plant surfaces also play an important part in controlling the distribution of moisture in the air layers near the ground.

The convective processes in the neighbourhood of plants differ from those in the open. Inside vegetation air movements are feeble and loss or gain of heat by convective processes is correspondingly suppressed.

Apart from the direct effect of solar radiation on plants there is also the shading effect of plants on the surface of the soil according to the density of foliage. This decreases ground heating. The micro-climate is influenced by the height and density of vegetation and therefore by the stage of growth of a particular crop during the growing season. Four stages in the evolution of plant climate may be broadly distinguished.[2]

In the first stage the seeds have just sprouted, the ground is yet bare and so the micro-climate is not essentially different from that over bare ground.

In the next stage, there is a lateral spreading simultaneously with vertical growth, with complete shading of the ground. The seat of diurnal transfer of heat is still near the ground but the micro-climate differs from that over bare ground. The temperature range at the ground is now considerably reduced.

In the third stage plants grow in height and foliage is more uniform with height. An interspace between the ground and the surface of vegetation is also created. The top surface of the crop absorbs solar radiation during day and radiates heat during night. It therefore acts as a second active surface besides the ground.

In the final stage, *e.g.*, in case of a forest, the foliage near ground is less, the second active layer is raised farther from the ground and appreciable air movement is possible in the interspace.

MICRO-CLIMATIC OBSERVATIONS INSIDE CROPS.

Measurements of air temperatures and humidity at various heights are being taken daily inside a few crops and in the 'open' in the Agricultural Meteorological Observatory, Poona, at the epochs of maximum and minimum temperature by means of an Assmann Psychrometer. Observations in the 'open', jowar, and sugarcane, indicate that while pronounced differences are found in the micro-climates of these crops as compared to the 'open' at the epoch of maximum temperature, the differences are not so great at the epoch of minimum temperature.

MAXIMUM TEMPERATURE EPOCH.

It may be observed that at the maximum epoch, the dry bulb temperature in the 'open' is very high near the ground and falls rapidly with height during clear weather. Temperature inside jowar near the ground is lower than in the 'open', but at higher levels it is slightly higher than at corresponding heights in the 'open'.

In the case of sugarcane (an irrigated crop) the dry bulb temperatures near the soil are much lower than those in the open as well as those inside jowar (an unirrigated crop) and they have a tendency to increase with height, but even at 6 ft. it is about 2° lower than that of the 'open'. The largest difference between 'open' and sugarcane is 14°C. near soil, 5·5°C. at 2 ft., and 3°C. at 4 ft.

There is a tendency for vapour pressure to decrease rapidly with height and inside crops the moisture content is higher at all heights than in the 'open'.

MINIMUM TEMPERATURE EPOCH.

Variation of micro-climate is much less at the epoch of minimum temperature. The dry bulb temperature decreases at first with height both in the 'open' and inside crops and then begins to increase, the level of inversion being about 6″ in the 'open' and about 2 ft. inside jowar and sugarcane. Temperatures inside jowar and sugarcane are higher than in the 'open' but tend to the open air value at higher levels.

Vapour pressure in the 'open' is throughout less than that inside crops. In the 'open' as well as inside jowar it increases with height. In sugarcane, however, it decreases with height in the lower levels but variation is negligible after 3 ft. Vapour pressure inside sugarcane continues to be higher than in the 'open' and inside jowar at this epoch also.

CORRELATION OF MICRO-CLIMATE OF CROPS WITH THAT OF THE 'OPEN'.

It would also be interesting to investigate whether the conditions inside crops could be expressed in terms of those outside. If the correlations are high and significant, then past observations in the open may be adjusted so as to give conditions inside crops. Analysis of some of the results for tall crops show that the morning correlations of dry bulb, vapour pressure, wet bulb and relative humidity inside the crops with

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* Report of a lecture at the Colloquium, Meteorological Office, Poona, on the 26th June 1934.

[1] L. A. Ramdas, "Micro-Climatology," *Curr. Sci.*, 1933-34, **2**, 445.

[2] Von Dr. Rudolph Geiger, "Microklima und Pflanzenklima," *Handbuch der klimatologie*, 1930, **Band I**, Teil D.

those in the 'open' are uniformly high, whereas those for the afternoon are smaller, especially at lower levels.

Further studies on these lines and for different crops have to be continued at a few representative centres before definite conclusions could be drawn. The results obtained so far are being discussed in detail elsewhere.

Agricultural Education in India.

By Dr. B. N. Iyengar, B.A., Ph.D. (Göttingen),
Deputy Director of Agriculture, Bangalore.

THE short note on the above subject by Mr. Agarwala published on p. 33 of July issue of the Journal tempts me to make a few observations.

Leaving aside the post-graduate institutions at Pusa and Bangalore mentioned by the author, all other institutions may be said to serve the purpose of training upper and lower subordinates to various Agricultural Departments in the country. Though Agricultural Colleges were established with a view to train up practical and scientific agriculturists, they seem to have failed to attract sons of the landed gentry who by virtue of their position and wealth may reasonably be expected to go back to their estates, run farms on modern lines and thus set examples to their tenants. Unless the Zamindars and large estate owners realise their duties towards their tenants and set an example to them by running a home farm themselves, agricultural improvement in this country may not go forward at a sufficiently rapid rate. It is well known that most of the agricultural improvements brought about in England and other European countries are mainly due to the efforts of landed gentry in those countries. Even to-day, it is private land-owners in England that are leading the country in the matter of stock as well as plant breeding. Even in the establishment of research institutions, private people gave the lead in England as is well known by the history of Rothamsted, the premier research institution of the world.

The course of studies followed in Agricultural Colleges of this country may be eminently suited to train good agricultural demonstrators for the subordinate services. Still it seems to be defective in a few essential points. The economics of agriculture are taught on farms where the plots are necessarily small and cost of cultivation consequently high. The practice in Europe is to ask students to go and work on private estates which are run on business lines and get certificates from the proprietors to the effect that the students have worked satisfactorily and understood the economics of crop production, management of labour, etc. Till such places of practical training are established by private persons in this country, it seems desirable for every Agricultural Department to run at least one farm on commercial lines making use of the successful results of all experiments to show their money value by practical demonstration and not merely by propaganda.

Such a step naturally brings with it a change in the course of studies. A theoretical course combined with practical demonstrations and plenty of workshop practice in modern agricultural implements and machinery should be the main feature in the early part of the course. The practical course to be followed later on must be devised for two kinds of students :–(*a*) sons of the landed gentry to enable them to go back to their own estates and become leaders in their respective areas, (*b*) people who desire to take up service as demonstrators, farm managers and such like.

At present, practical work such as ploughing, forms an examination subject and a certain amount of proficiency is expected in it. Such practical examinations should be modified to suit various types of students. Just as Engineers are not examined in the practical work of road making, trench digging, brick making, wall construction, mortar grinding, etc., too much stress on proficiency in practical field operations of agriculture does not seem to be necessary in the case of those who are to manage estates and are not expected to do the work themselves.

The second type of institution is the agricultural school where boys of the cultivating classes get a training in the theory and practice of agriculture. They are mostly vernacular schools. Even in these schools much time should not be spent on operations which the boys can learn from their elders on their own fields. As the European farmer says, boys must be taught things which they cannot learn in their own place, *e.g.*, about modern implements, new manures, methods of seed selection, etc. Even in these vernacular schools, a large majority of students seem to be from non-agricultural classes and go through the course simply with the object of getting into the lower ranks of service. Consequently, steps have to be taken to attract boys who will go back to cultivate their own lands and practise an intensive system of agriculture.

It would be seen from the above that the whole system of agricultural education needs to be overhauled to suit various types of students that are to be benefited by it.

Himalayan Expeditions, 1934.

THE two Himalayan Expeditions, which attempted to negotiate the unconquered peaks of the Himalayas, have both been abandoned. The German Expedition, led by the well-known Herr Willy Mercle, was given up under tragic circumstances, the leader having met his end with three of his companions and a retinue of porters, before they proceeded very far. Another Expedition which was organised by the Indian Himalayan Expedition Club, did not materialise, as it is understood, necessary permission was not granted by the Government of India.

International Commission on High Dams.

THE First Congress of this International Commission was held in Stockholm during June and July 1933. A number of very interesting papers were read by recognised authorities on the subject. These have now been published as the Proceedings of the First Congress in five volumes under different sub-heads. A short review of the papers dealing with the sub-head "Study of Physical Laws Governing Infiltration of Water through Earth-field Dams or Masonry Weirs on Sand Foundation", is given below.

With regard to the different forms in which the water appears in the earth, the classification adopted by Zunker[1] is mentioned and in connection with the same it is observed that the following forms with reference to the movement of water in dams must be examined:

1. The true seepage flow, that is to say, the movement of water which takes place exclusively under the influence of gravity and friction.
2. The capillary seepage flow in which, in addition to gravity and friction, capillary forces affect the movement.

The first case occurs when the flow is below a masonry weir under sand foundation or such other cases where there is no free surface of water in the sand medium. The seepage flow is a potential flow and can be treated mathematically according to the laws of potential theory.[2] As is shown by many tests[3] Darcy's Law holds good for this movement. Special emphasis is given to the electrical method[4] of investigation, which can, if necessary, be supplemented by trials with dam models through which water is flowing. The theoretical flow process can be completely and fully deduced from a complete flow diagram showing the network of flow and potential lines. The volume[5] of water flowing below a masonry floor can also be calculated.

When the medium through which water is flowing is not homogeneous the problem is more difficult; however, one can arrive at the movement of the water within each homogeneous layer. In addition to the usual boundary conditions which obtain with soils that are homogeneous throughout, there must also be taken into consideration the condition for the transit of water from one material to another. The model rule[6] that must be complied with, in such cases in order to achieve similarity of stream line diagrams both in the model and the prototype, is that the ratio between the coefficient of permeability of the individual layers under the model to be in strict conformity with that of the corresponding strata in nature.

Two types of flow are to be distinguished in connection with the capillary seepage flow:—

(*a*) The accompanying capillary flow—this refers to that movement of the water which occurs in the strip of soil that lies above the zone of the free seepage flow.

(*b*) The capillary seepage flow—in this case the water is always free, that is to say, it does not fill the whole of the pore space.

The laws governing these types of flow are still entirely unknown. For the builder of earth-filled dams, it is above all things very important to know the correct position of the seepage line. It has been shown[8] that for simple cases the theoretical flow diagrams agree with the conditions in a model and one may expect that this agreement will be maintained to a sufficient degree in the actual dam. It is stated that the capillary flow acts quite differently in the model and the prototype and as a result the laws for model naturally lose their value unless it is possible to apply the same model laws for the capillary flow. This would be possible if a liquid is used in the model the capillary elevation of which was equal to $1/n$th (n the scale ratio of the model) of the capillary elevation in the soil of the prototype.

N. K. BOSE.

[1] F. Zunker, *Handbuch der Bodenlehre*, 1930, 6 Bd.

[2] Ph. Forchheimer, *Zur Grundwasserbewegung nach Isothermischen Kurvenscharen*, Wien, 1917.

[3] Th. Rehbock, "Sickerwasserbewegung im Erdreich." *Proceedings of the First Congress of High Dams*, 1933.

[4] N. N. Pavlovsky, *The Theory of Groundwater-flow under Hydrotechnical Structures*, U. S. S. R. Leningrad, 1921.

[5] T. Schaffernak and R. Dachler, *Versuchstechnische Lösung von Grundwasserproblemen.*

[6] R. Dachler, *Uber Sickerwasserströmungen in geschichtetem material.*

[7] B. Korner, *Erförschung der Physikalischen Gesetze, nach welchen die Durchsicherung des Wassers, durch eine Talsperre, order durch den Untergrund stattfindet.*

[8] R. Dachler, *Der Sickervorgang in Dammböschungen.*

International Conference of Physicists.

UNDER the auspices of the International Union of Physics and the Physical Society a Conference will be held in London in October, Professor Millikan and Lord Rayleigh presiding. The business of the Conference will include a discussion on nuclear physics, and a discussion on certain aspects of the theory of the solid state of matter. There will also be presented to the Conference a report from the Symbols, Units and Nomenclature Commission of the International Union of Physics. By the courtesy of the President and the Managers of the Royal Institution, the London meetings will be held in the Lecture Theatre of the Institution. At the invitation of Lord Rutherford the Conference will meet one day at the Cavendish Laboratory in Cambridge. Among the social events of the week will be included a reception by the President and Council of the Royal Society and a visit to the National Physical Laboratory.

Science Notes.

Al-Kindī's Theory of Colour of the Sky.—Mr. Zaki Uddin of the Muslim University, Aligarh, writes:—"C. Brockelmann (*Gesch. der Arabischen Literature*, Vol. I, p. 209) has mentioned only a few of the surviving manuscripts of the great Arab Philosopher and Scientist Yaqub b.Ishaq al-Kindī, who has written about 300 treatises on various subjects of science and other branches of knowledge. Out of these manuscripts one No. *MSS. Sed. Arch.*, A. 32, p. 374, preserved at the Bod. Library at Oxford and at Constantinople Aya Sofya Library MSS. No. 4832 is not only important for a student of modern science but also interesting. This MSS. deals with the explanation of the blue colour of the sky, and is the first manuscript available for adding to our knowledge regarding the theory of colour between the age of the Greek Speculators and the famous Arab Scientist, Ibn-al-Haitham (Alhazen with Latin name). Although a number of speculations regarding the cause of the colour of the sky can be found scattered here and there, it was not before al-Kindl that an authentic explanation was given. The important treatise of Aristotle (Opuscula, Oxford 1913) dealing with the General theory of colour does not contain much about this problem.

"Recently the MSS. has been edited and translated into English by Prof. Dr. O. Spies, Professor and Chairman, Department of Arabic, Muslim University, Aligarh, and by me. The translation reveals a number of interesting points and it would be worthwhile to consider and compare the 'old crude ideas' of the ancients with the modern view.

"We know to-day that the colour of the sky is due to the dispersion of the rays of the sun by the atmosphere. This is the result of the investigation of the modern physicists."

When we read in the manuscript of al-Kindl the following, we cannot but appreciate 'one of the twelve greatest minds of the world' (according to Cardano):—

"Now above us, shadowy air has become visible on that what light of the earth and the light of the stars mixes colour in the middle of the shadow and light and that is the blue colour. So it is evident that this colour is not the colour of the sky but it is a thing which is exposed to our sight."

A detailed account of the theory of colour of al-Kindl with the original text and translation will be published elsewhere.

(It would be worthwhile to draw the attention of the students of optics interested in the work of Ibn-al-Haitham to the Corpus of al-Kindl's works discovered by H. Ritter (*Archiv Orientelni*, Prague, 1933, pp. 363–372) and by me at the Oriental Library at Patna dealing with the theory of propagation of the rays of the sunlight. The later MSS. entitled "risāla fī mutārih ash-shua" is a copy of an older MSS. of the "madrasah al-Kamilia" at Cairo, and was copied in the 8th century A.H. It would be interesting to publish a translation of the same.)"

* * *

Earthquake in the Panama Canal Zone.—An earthquake shock of great intensity at its origin about 10,200 miles from Bombay was recorded by the Colaba seismographs at 7 hrs. 26 mts. I. S. T. on Wednesday, the 18th July 1934. It appears from the newspaper reports that the shock originated near Costa Rica in the Panama Canal Zone. The earthquake is reported to have caused considerable loss of life and damage to property. A concrete work recently built at a cost of £ 60,000, in Puerto Armuelles was completely destroyed.

* * *

Asiatic Society of Bengal.—An ordinary meeting of the Asiatic Society of Bengal was held on Monday, the 6th August. One of the interesting papers that was presented before the meeting was on the "*Saddharmapaundarika*: A Collection of Central Asian Memoirs of the Lotus of the True Law", by N. Miranov. From his study of the different sets of the Central Asian Manuscripts, the author distinguishes, according to the script, two groups of manuscripts: (1) Those in the *Upright Gupta* Script, and (2) those in the *Calligraphic Upright Gupta* Script. "From the comparison of the different sets with other Central Asian Manuscripts and with the Indian epigraphic monuments, the author assigns the first group to the 5th-6th centuries, and the second one to the 7th century. A comparison with Chinese versions permits to assign the recension of the text represented by the 1st group to the 3rd century A.D. and the text of the Calligraphic Upright Manuscripts to the 6th century. Up to the present chiefly manuscripts of the latter group have been published or made use of (like the manuscript of the Bibliotheca Buddhica Edition studied by Kern), those of the first one are comparatively little known.

"The present collection contains the remains of *three* manuscripts in the Upright Gupta Script, whereof one (A = 12N°N° or 25 Frgg.) belongs to the oldest stratum (middle of the 5th century), while the two others (B and C=20N°N° or 31 Frgg.) are slightly younger going back to the 6th century. The manuscript in the Calligraphic Upright Gupta (D) is represented but by 2N°N° (=7 Frgg.).

"The author has added, in an appendix, the edition of *five* Frgg. of the 'Lotus' from the *Stein* Collection (India Office Library, London), of which two (S. I, S. II), written in the Upright Gupta Script, are three almost complete leaves, while the rest are important from the literary point of view, giving nearly the same text as some Frgg. of the Otani Collection.

"The author has, in his paper emphasised the far-going deviations of the Central Asian recensions, as far as the language is concerned. The manuscripts in the Upright Gupta Script are written throughout in mixed or Buddhist Sanskrit, *i.e.*, represent a Prakrit base overlaid with a faint Sanskrit varnish. Considering the importance of this form of speech of which no Buddhist text is free, the author has compiled a grammar of his texts dealing with both the Phonology and Morphology; he has tried to assign the proper place among the Prakrit languages to the dialect to which Buddhist Sanskrit goes back. Such a grammar will be useful to any student of Buddhist literature, a systematic treatise on the subject being badly lacking. Our present knowledge of Buddhist Sanskrit is confined to a few accidental notes in the editions of Buddhist

texts (not to speak of Rajendralala Mitra's work of the early eighties which is out of print)."

* * *

An Unusual Meteor.—Mr. Zaki Uddin of Aligarh University writes: On Monday, the 23rd July 1934, at 9-30 p.m. an unusual meteor appeared above the clouds that hovered over the horizon of Aligarh. The meteor started from South-West and travelled South-East at about 50° with unusual brilliance, lighting the ground for about 15 seconds. At the beginning it appeared like a ball of fire, that afterwards developed a source of extraordinary light. Later on, it began to emit bright bluish light, and just before disappearing increased in brilliance and split into two portions at about 20° from horizon. It is said to have fallen near Hapur about 40 miles from Delhi. This phenomenon observed was extremely abnormal.

* * *

Sugar Industry in India, 1932-33.—Review by R. C. Srivastava.—During the last few years the sugar imports to India have rapidly declined as a result of the growth of Indian sugar industry which has increased the production of white sugar under the very favourable protective tariffs. Almost coeval with the rise of factory industry the 'Khandasari' or open pan system has also expanded and its productive figures have been mounting in the recent years. Results on the agricultural side are also marked. Although the acreage under cane has increased by 10% cane production itself has risen by about 30% which is due to the increasing adoption of improved varieties of cane. An examination of the sugar production figures for the last thirteen years shows the beneficial effects of the tariffs on the industry which has suddenly increased the output of sugar at the closing years of the said period. Also there has been an increase in the number of new factories erected for operation.

Technical and scientific work on cane breeding at the Coimbatore Station has produced several improved varieties of cane now being adopted in the different provinces with success. Some of the varieties CO 281 and CO 290 have been recognised in Queensland and Natal as disease-resisting. Among the other varieties may be mentioned CO 213 in U.P., CO 205, 223 and 285 in Punjab, CO 213 in Madras which have been extensively grown and found to be very satisfactory in the respective provinces.

Total sugar machinery imports during 1932-33 exceeded a crore and a half rupees, nearly two thirds of this amount being spent on British machinery alone. Among the 58 newly erected factories two plants have been entirely built in India and are quite up-to-date.

Due to the recent expansion of the home industry not only have the imports of sugar, both by land and sea, diminished and total home production risen, but there was practically no import of gur or jaggery from neighbouring countries. Java has suffered in her sugar trade by the Indian import duties as also by the Sino-Japanese conflict in Manchuria and England's relinquishing of the Gold Standard. As a result of the accumulation of large stocks measures of restriction of production and centralisation of selling control were adopted. Cuba also had to face a severe disappointment as even the Chadbourne agreement failed to raise the level of prices and Cuba losing a large share of her American market had also to close down 50 out of 183 centrals. As compared with the previous year there was a decline of 3·2% in the total world sugar production there being a 16·4% fall in Europe's beet sugar alone in 1932-33.

The prospect of Indian Industry is hopeful especially in view of the check which the fear of an unhealthy expansion of the industry under very favourable tariffs has received from the new excise duty levied by the Government. The problem, however, of raising the Indian sugar consumption which has remained at a very low figure has still to be faced, otherwise the industry is threatened with the evil of over-production in the course of a few years.

* * *

According to a report in the *Chemical Age* the Maharaja of Kolhapur has granted to a British Syndicate the monopoly of commercially utilising the mineral deposits of the State, especially bauxite. The Syndicate will be formed by the promoters of the scheme and it is said that Sir Basil Blackett will be the Managing Director. An important Aluminium Industry may come into existence in the State.

* * *

A joint meeting of the Society of Biological Chemists, India, and the Grant Medical College Physiological Society was held on Friday, 27th July 1934 at 3-30 p. m. in the Physiology Theatre of the Grant Medical College when Prof. R. H. Dastur read a paper on "The Chemical Mechanism of Respiration".

Major S. L. Bhatia, Dean of the Grant Medical College, presided.

* * *

Biochemical Society, Calcutta.—With the object of the promotion of biochemical studies and research a Biochemical Society has recently been formed at Calcutta. The Society was formally inaugurated on the 6th July at the All-India Institute of Hygiene and a paper on the "Metabolism of Carotene" by Dr. B. Ahmed was read. It has been arranged to hold monthly meetings for biochemical discussions and reading of original papers, reviews, etc.

The first Committee of the Society has been composed of the following:—

Prof. N. M. Basu, Lt.-Col. T. C. Boyd, Prof. Sudhamoy Ghosh, Prof. J. N. Mukherjee, Dr. B. B. Sen, Prof. H. K. Sen, Prof. H. E. C. Wilson, with Dr. B. C. Guha as Hony. Secretary and Dr. B. Ahmed as Hony. Treasurer.

The Society has already evoked an all-round response as the lack of a common meeting ground has been felt for some time by the local workers, and successful meetings are being held. It is hoped that the Society will help to advance the cause of Biochemistry in India.

* * *

Royal Institute of Science, Bombay.—Mr. K. H. Vakil, Member of the Advisory Board of the Institute, specially visited the Institute to inspect the research equipment.

The Institute was closed on 27th July as a mark of respect to the memory of Sir Cowasji Jehangir (Sr.) whose death took place on 26th July at Poona. The late Sir Cowasji Jehangir was one of the three leading persons responsible for the foundation of this Institute, donating altogether about Rs. 7½ lakhs. A condolence

resolution was passed at a meeting of the staff and students.

Prof. Gunjikar (Prof. of Mathematics) is proceeding on a short leave out of India. Mr. S. D. Manerikar, B.A. (Cantab.), will work during his absence on leave.

Dr. N. R. Tawde, B.A., M.Sc., Ph D. (London), A.Inst.P., is appointed Lecturer in Physics.

* * *

Calcutta University.—It is understood that Mr. Syama Prasad Mukherjee, son of the late Sir Ashutosh Mukherjee, has been appointed Vice-Chancellor of the Calcutta University, in place of Sir Hassan Suhrawardy whose term of office expires this year. It is also understood that the Syndicate of the University have recommended that the degree of *Doctor of Science* be conferred on Sir Suhrawardy, retiring Vice-Chancellor, at a special convocation to be held at the Government House in the first week of August.

* * *

Prof. H. E. Watson, lately Professor of General Chemistry, Indian Institute of Science, Bangalore, has been appointed to the Ramsay Memorial Chair of Chemical Engineering at University College, University of London, in succession to Prof. W. E. Gibbs.

* * *

The Tenth International Exhibition of Inventions will be held at the Central Hall, Westminster, London, from October 3 to 13, this year.

* * *

German Association of Men of Science and Physicians.—According to a report appearing in *Nature*, the Ninety-third Meeting of the Association will be held at Hanover on September 16—20. "This is the first meeting under the new constitution and an impressive proclamation of German Science is desired. Exhibitions and Excursions are planned. The Exhibition dedicated to 'Deutsches Volk—Deutsche Arbeit' is to give a picture of the history of German race with emphasis on heredity, genetics and eugenics and also on Chemistry as a domain in which intellectual leadership is fundamental for industry."

* * *

Scripta Mathematica Library.—Scripta Mathematica has in the course of preparation a series of small volumes to be known as "The Scripta Mathematica Library". This series will deal with the history and philosophy of Mathematics and with its relations to the other great activities of the human spirit. Each volume will contain at least 96 pages. Some of the proposed titles are:—(1) Poetry and Mathematics and other essays—by David Eugene Smith; (2) Mathematics and the question of Cosmic mind with other essays—by Prof. Cassius Jackson Keyser, and (3) Fabre and Mathematics and other essays—by Prof. Leo. G. Simons.

Scripta Mathematica also offers to any Library in India, *free of charge*, the following pamphlets. (1) Thomas Jefferson and Mathematics—by David Eugene Smith, and (2) The Meaning of Mathematics—by Cassius Jackson Keyser.

* * *

The Progress of Radio Research: Report of the Radio Research Board for the period, 1st January 1932 to 30th September 1933. His Majesty's Stationery Office, Price 2*s.* 6*d.* net. (Post free 2*s.* 9*d.*)

Knowledge of the work carried out under the Radio Research Board of the Department of Scientific and Industrial Research is essential to anyone wishing to keep abreast of advances in research on the propagation of waves, direction finding, atmospherics, and improved methods of measurement at radio frequencies. The progress of the Board's investigations on these subjects is summarised fully in the recently published Report.

* * *

A new reaction for cantharidine, applicable to its estimation by colorimetry has been described by Georges Deniges in a paper communicated to the Academy of Sciences, Paris. The method is based on the colouration produced by heating cantharidine with formol and sulphuric acid.

* * *

In a paper communicated to the Academy of Sciences, Paris, Vellard has described his observations relating to the periodic destruction of the fauna of the rivers of the Grand Chaco by variations of salinity. "The fish die as the salinity increases through evaporation and are deposited in enormous blocks. This is of interest from the geological point of view as it gives a possible explanation, better than any other hypothesis, of the formation of certain banks of fossil fishes, the origin of which is otherwise difficult to understand."—*Nature.*

* * *

A New Ceramic Ware of Water Absorption of Nil.—"No property of Stoneware," says Felix Singer (*Chemical Age*, 1934, **30**, 553), "is of such decisive importance for many of the purposes of the Chemical Industry as its degree of water absorption." The production of a new English ware "Alchemie" (by Doulton and Co.,) with no absorption at all, can therefore be considered as an achievement of first importance in Chemical Industry. In spite of the reputed and resisting properties of Stoneware, its extensive use was limited by the water-absorbing property it possesses. The production of "Alchemie" has now made possible the employment of the ware, freely, in foodstuff industries, in all processes where use is made of hydrogen peroxide or other *per* compounds, in the manufacture of taps and such other plant accessories, in chemical works and in several other industries where stoneware is usually considered the best, nay, the only material that can be used for certain apparatus.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 133, Nos. 3371 to 3375.
"The Chemical Age," Vol. 30, Nos. 780 to 784.
"Canadian Journal," Vol. 10, Special Number and No. 6.
"The Journal of Chemical Physics," Vol. 2, No. 6.
"Berichte der Deutschen Chemischen Gesellschaft," 67 Jahrg, Nos. 6 and 7.
"Natural History," Vol. 34, No. 4.
"Journal of Agricultural Research," Vol. 48, Nos. 5 and 6.
"Experiment Station Record," Vol. 70, No. 5.
"American Journal of Botany," Vol. 21, No. 6.
"Journal de chimie Physique," Tome 31, No. 5.
"Science Progress," Vol. 29, No. 113.
"The Science Forum," Vol. 1, Nos. 1 and 2.
"The Journal of Nutrition," Vol. 7, Nos. 1 to 6.

"The Review of Scientific Instruments," Vol. 5, No. 6.
"Scientific Indian," Vol. 11, No. 66.
"Indian Forester," Vol. 60, No. 7.
"Medico-Surgical Suggestions," Vol. 3, No. 6.
"Forschungen und Fortschritte," Jahrgang 10, Nos. 17, 18 and 19.
"Journal of Agriculture and Livestock in India," Vol. 4, Part III.
"The Indian Journal of Veterinary Science and Animal Husbandry," Vol. 4, Part II.
"Indian Forest Records," Vol. XX, Part 6 (Entomological Series).
"The Indian Trade Journal," Vol. CXIII, No. 1462 and Vol. CXIV, Nos. 1463 to 1465.
Govt. of India Publications: "Forest Bulletin" No. 83 (Sylvicultural Series) 1934.–Provisional yield Table for *Quercus incana* Roceb.
Department of Commercial Intelligence and Statistics in India: "Monthly Statistics of the Production of Certain Selected Industries of India," March 1934, No. 12.
"Journal of the Institute of Brewing," Vol. XL, No. 7.
"Scripta Mathematica," Vol. 2, No. 3.

Reviews.

RASSENKUNDE UND RASSENGESCHICHTE DER MENSCHHEIT. By Egon Freiherr von Eickstedt. (Stuttgart. 1934). Price RM. 76·50.

The number of really authoritative text-books on Anthropology issued so far is relatively small and it has, therefore, been a matter of great difficulty for workers in this science to get together the necessary information except by wading through a great deal of scattered literature in not easily accessible scientific periodicals and various manuals. Martin's "Lehrbuch" of which a second edition was published in 1928, Saller's "Leitfaden der Anthropologie" (1930) and Wilder's "A Laboratory Manual of Anthropometry" (1920) are amongst some of the most authoritative publications, but still there was the necessity for an up-to-date and carefully prepared work dealing in detail with the very important questions of the different races of mankind and their history. Such a work is the one under review, published by Prof. von Eickstedt of Breslau University. This handbook differs from the older works in that it contains as exact and detailed an account as possible of the complicated question of the races of mankind, based on a careful study of the extensive literature and the personal researches of the author not only in the laboratory but also in different continents. In addition to dealing with the races under four major groups, *viz.*, Asiatic, European up to Sahara, Negroid Africa and Oceania and the two Americas, the author has dealt with in detail the development of the various epochs of the history of the different races and their connections with the continental and other changes. The author carried out a great deal of anthropometric measurements of the various races and more particularly of the primitive tribes of India, and though one may not agree with all his conclusions, the information in reference to these tribes, which is incorporated in the volume, would prove invaluable to students of Anthropology in India.

The publication is beautifully illustrated and the large number of specially prepared maps add greatly to the value and importance of the work. It should create a great deal of interest in anthropological studies for the carrying out of which correct lines are indicated.

B. P.

ELEMENTARY DYNAMICS. By R. C. Gray, (Macmillan & Co., Ltd., pp. xi+211, 1934.) Price 5*s*.

The author in his preface states that the book is intended for students beginning a University course in engineering or other applied science and that the subject is treated as an introduction to applied science and not as a branch of mathematics. The book deals in a particularly clear and simple manner with the essential portions of particle and rigid dynamics. The introduction of a few of the topics usually dealt with under statics and a chapter on gyroscopes form a welcome innovation. The treatment is anything but hackneyed and there are very few books of this sort which keep an eye to the practical applications of Dynamics in Engineering. The examples have been very carefully chosen, but one cannot get over the feeling that the majority are unnecessarily too numerical.

In such a well-trodden field where there is a bewildering variety of text-books differing from each other in their content as well as method, it is very difficult to assess the value of any new book on the subject. This book, based as it is on the syllabus of

Prof. Gray's lectures in the first year course at Glasgow University, maintains a wholesome balance between clarity and comprehensiveness. Although the author has not used the calculus explicitly, he makes skilful use of the conceptions of the calculus in deriving the important principles. The Chapters on Friction and on Work, Power and Energy are particularly well written.

The get-up and printing of the book are excellent and the price too is quite reasonable. It can be safely recommended as an excellent introduction to Elementary Dynamics specially suited for the Engineering and Pass courses in Mathematics of our Universities.

B. S. M.

THE PRACTICE OF ABSORPTION SPECTROPHOTOMETRY. By F. Twyman, F.INST.P., F.R.S., and C. B. Allsopp, M.A., Ph.D. 2nd edition. 144 pp. Royal 8vo. 40 illustrations, bound in cloth boards, June 1934. 12*s.* 6*d.* nett, 12*s.* 9*d.* post free. (Adam Hilger, Ltd. London.)

The subject of absorption spectroscopy has assumed such importance in both theoretical and applied chemistry that it is pleasant to record that, although it is only a little more than two years since the first edition of this book appeared, it has already been found worth while to publish a new and completely revised edition. The book has been entirely recast and enlarged. The present edition is divided into two parts, the first of which contains an introduction to the theory of absorption, including a simple description of molecular spectra, and an account of various typical applications of absorption spectroscopy, in which the interests and requirements of the theoretical, industrial and biological chemist have each been kept in view. An attempt has been made to introduce a much-needed uniformity in the nomenclature of absorption spectroscopy by adopting that set out in the International Critical Tables of 1929, a step which could profitably be followed by all workers in this field.

In Part II, the technique required in photometric measurements of absorption is described and explained. A chapter in this section discusses the conditions which are necessary for obtaining accuracy in the various types of measurement involved, and this is followed and illustrated by a detailed account of the principles and use of typical instruments which have been developed by Adam Hilger, Limited, for spectrophotometry in the ultra-violet, visible, and infra-red regions of the spectrum. One of a number of appendices describes a new method of applying absorption methods in the textile industry which may have far-reaching consequences. The book will be of interest to workers already engaged in absorption measurements; while to those to whom the subject is new and who are contemplating such work it will be invaluable. It could also be read with profit by advanced students, both on the theoretical chemical side, and on the technical side of the subject.

SATELLITE STATION TABLES. By C. M. L. Scott. (Edward Arnold & Co., London, pp. 44.) Price 12*s.* 6*d.*

Satellite stations are a necessity in unsuitable country, where it is not practicable to choose main direct stations. Owing to the tedious calculations involved in the so-called "Reduction to centre", endeavours are sometimes made to avoid satellite stations. As a result, labour and time are spent to alter the main stations, while trying to choose places where instruments can directly be set up in preference to desirable prominent points that necessitate observations from a satellite station.

The author of this volume has done great service to the Surveyor. He has, by the publication of these tables, enabled saving of time and labour involved in "Reduction" where "False Stations" are introduced and has at the same time made possible a free choice of suitable satellite stations. The tables can be used for easy and quick reduction, without, what is more important, sacrificing accuracy. Where very great accuracy is not required, a further saving in time and labour in reduction to centre can be made by the use of the graphical method explained in Appendix I. With the help of the disc enclosed in the pocket at the end of the book, corrections and the signs of corrections to be applied to the observed angles, to get the angles at the True Station, can be rapidly got. The graphical method is particularly useful where many readings from the same satellite station have to be reduced.

A variety of problems can be solved by the use of Satellite Station Tables with ease. Several worked out examples are given in Appendix I indicating the use of these tables in the solution of Survey Problems and it will readily be seen that the use of these

tables can be easily extended to a number of other problems. The wide applicability of these tables enhances the usefulness of this book.

The book is well written and the preparation of the Tables must have entailed great labour. The work of the publisher is good and the volume is sure to be an useful addition to the Library of a Surveyor or an Engineer.

K. D. JOSHI.

TELEVISION: THEORY AND PRACTICE. By J. H. Reyner. (Published by Chapman & Hall. Ltd., pp. x+ 196.) Price 12*s*. 6*d*.

Although Television has not yet become a commercial success, it is doubtful if there is any other field which has caught the fancy of both the amateur and the layman. It is but natural that such an interesting subject should call the attentions of Radio Engineers and Experimental Physicists to supply the necessary fundamental knowledge to the general public. Mr. Reyner's book is an answer to this call.

It is rather an ambitious programme to condense all the theory and practice of this vastly interesting field in a small volume of less than 200 pages, for Television, unlike its sister science, lays claim over a vast domain of Experimental Physics. An attempt to bring together all these, in a small space, naturally involves an elaboration of certain points, and a scanty reference, if not a complete neglect of other equally important branches. It is remarkable, however, that the author has cleverly managed the situation. By completely omitting to mention certain old devices which are now more or less historical, or only attract the attention of the curious, he has emphasised the more important principles involved in Television.

The book opens with a general definition of what television is. The methods of scanning, and the factors that determine the detail, and clearness of television pictures are briefly discussed. A complete chapter is devoted to a description of the eye, and other optical arrangements without which no book on television can be complete. Next, the author deals with Photo-electric cells; the real backbone of television transmitting apparatus. While there is adequate matter to serve as a good background to the proper understanding of the subject, one feels that sufficient importance has not been given to this very important item. Then we come to what is perhaps the most important part of the text, namely, the 'Cathode Ray Tube'. The treatment of this is worthy of praise. The construction of the cathode ray tube, and its practical application to television have been given all the importance they deserve; no doubt in view of the fact that the cathode ray tube has to play an important rôle in television receiver of to-morrow. There is also a chapter devoted to the television receivers, in which the performance of resistance-coupled amplifiers and direct coupled amplifiers are briefly discussed. The rest of the book gives a fleeting review of Continental and American systems that are in vogue to-day. Finally the book closes with a brief but critical review of all that has been achieved in the field till now; and the visualisation of what it is going to be in future is resplendent with a rosy optimism. The get-up of the book is of a high order, the photographs and diagrams are adequate, and help to elucidate the text. The book can be confidently recommended to all those interested in this vastly absorbing field.

C. C.

UNIT PROCESSES AND PRINCIPLES OF CHEMICAL ENGINEERING. By John C. Olsen, PH.D., D.SC. (Macmillan & Co., Ltd., pp. XIV+558) Price 25*s*. net.

This co-operative work by a group of successful American Chemical Engineers is a valuable addition to the not very large number of up-to-date text-books available in the field. The book has been developed by presenting the fundamental physical and chemical principles determining the course of a chemical reaction and a few of the unit processes which must be utilised in carrying out a given reaction on a commercial scale with a combination of some of these processes in their proper order constituting thereby an entire process for the production of a given product.

It is not attempted to make the book exhaustive by a presentation of all the different possible unit operations but to emphasise only on the fundamental aspects brought up-to-date of a few of the most fully studied and well-developed processes like Evaporation, Distillation, Filtration and Drying. The supplementing of a knowledge of the remaining Unit Operations has been left to the reader for a further

study on the lines indicated during the course of the book.

A special feature of this volume is the inclusion of separate chapters on modern processes like the Absorption of Gases, Electric heating and the Electrolysis which are being systematically employed in industrial practice to an increasing extent. The Editor must be congratulated on his wisely incorporating into the book the concluding chapters on the all-important subjects like the materials of construction, costs and financing and Factory Location in that they bring out clearly the importance of a knowledge of Applied Economics to a Chemical Engineer in his daily routine. Most of the chapters contain at their end a set of well-selected problems illustrating and developing the ideas detailed in each chapter with also a short bibliography guiding the reader in the choice of books to secure a more exhaustive knowledge of the subject.

This book can be recommended to meet the requirements of students to obtain an elementary but a clear understanding of this vital subject so important to but still in its infancy in India.

A. N. RAO.

TOADS AND TOAD LIFE. By Jean Rostand. Translated by Joan Fletcher. (Methuen & Co., Ltd., Essex Street, London, pp. xii+185, 1933.) Price 7*s*. 6*d*. net.

To the generality of people the common toad is a repulsive creature, but to the biologist it is perhaps one of the most fascinating objects of study and observation. The cobra and the toad are animals around which quite a volume of superstitious beliefs has grown few of which, however, are borne out by facts. The nocturnal and solitary habits of toads, their warty skin, ejection of urine on handling, large protruding eyes, their uncanny silence and sudden appearance and disappearance have all tended to invest these animals with an awesome character which is foreign to its nature and temperament. They have been curiously enough reared as pets by ladies who testify to their power of educability and good behaviour. The book is a tribute to the decent manners and romantic nature of toads which after all do greater service to mankind than most of its members.

The book provides an excellent and accurate account of the general habits of the toads with short but sufficient reference to the anatomy and development free from technical terms. The principal value of books of this type is to educate the popular mind, remove misconceptions and induce habits of sympathetic observation and collate them into some general order of scientific data. The book fulfils its object in an eminent degree. In the twenty chapters, into which the book is divided, the reader obtains a full and authoritative account of everything worth knowing about these obscure and puzzling batrachians. When we lay down the book after reading the last chapter, we feel that buried under a phlegmatic temperament, there is on the toads a great deal of energy and character and their service to man is capable of elevating them to membership of polite society.

The book is illustrated by every phase of toad life and is provided with bibliography. It has a great educational value in giving the reader a body of carefully arranged information and in stimulating his observation on other animals in his surroundings.

REPORT ON BURMESE FISHES COLLECTED BY LT.-COL. R. W. BURTON FROM THE TRIBUTARY STREAMS OF THE MALI HKA RIVER OF THE MYITKYINA DISTRICT (Upper Burma). Parts I and II. By Dev Dev Mukerji. *Journ. Bomb. Nat. Hist. Soc.* Vol. XXXVI, pp. 812-831 (1933) and Vol. XXXVII, pp. 38-80, 3 pls. (1934).

The paper under review is one of the most detailed accounts of the Burmese fishes published within recent years. The account is based on a large collection of fish collected by Col. Burton at the instance of the Bombay Natural History Society. The collector believed that there are 80 species available in the area, but he obtained only 50. The material on careful analysis, however, showed that there were only 32 species in the collection and the author has dealt with the entire collection in great detail, giving a careful account with illustrations, where necessary, of the various species and elucidating several difficult problems of taxonomy and clearing up the synonyms of a large number of hitherto inadequately described or poorly known species.

The paper under review is one of most careful works on the fish fauna of any part of India published within recent years and it fills up an important gap in our

knowledge of the fishes of India. It is hoped that such studies on the fish faunas of other parts of India would be published by authors who are in a position to deal with the faunas of the different parts of the extensive continental area of India, as that alone will enable the compilation of a new edition of the "Fauna of British India" (Fishes) which is a great desideratum at the present day. The old "Fauna of British India" (in two volumes) by Dr. F. Day, published in 1889, is entirely out of date, and though useful as a work of reference, in view of the recent advances in our knowledge of the fish fauna of the world, is hardly acceptable as a standard publication.

B. P.

THE SCIENTIFIC JOURNAL OF THE ROYAL COLLEGE OF SCIENCE. VOL. IV. (Edwin Arnold & Co., London, pp. 171, 1934.) Price 7*s*. 6*d*. net.

The Journal published in a book form contains seventeen papers read during the session 1933–34 before the Imperial College Chemical Society, the Royal College of Science Natural History Society Section and the Royal College of Science Mathematical Physical Society. The seventeen papers are distributed in the order of seven, six and four among the above institutions and they embrace a variety of interesting and important subjects.

The lectures on Gold, Aluminium and Vitamin D are of great interest and form an excellent document of readable matter. The other papers in the chemistry section such as those on the chemistry of Nitrogen and the structure of sesquiterpene group and water of crystallisation and shapes of molecules are technical and illuminating.

The paper on "the Distribution of *Salicornia Europea* at Ynyslas, Dovey Estuary" is the abstract of a student lecture and is a praiseworthy contribution to the Natural History Society. Professor C. D. Darlington's lecture on "Mechanical Aspects of Nuclear Division" sets forth the mechanical relationships of cell-physiology, genetics and evolution to the morphological study of nuclear division and of meiosis, and lines of immediate advance in research of quantitative studies of nuclear division are indicated. The lecture on "The Romance of Grass-land" is an exceedingly interesting exposition of the development of the present-day grass-lands from the forested lands of primeval times. There is an element of pathos in the spectacle of mighty trees being felled for milling purposes, and the grandeur of the primeval forest thereby destroyed, but there is romance in the process of grass-land creation which begins when the agriculturist follows in the path of the timber-getter. An equally interesting paper is that on "The Purpose and Natural Selection, a Defence of Teleology."

In the Mathematical and Physical Science Section, the papers on "Foot Measurements for Shoemakers and Noise—Its Measurement and Abatement" are ingenious studies.

The fourth volume of the Journal maintains the high standard set up by the previous publications and they together constitute an excellent reference work.

Errata.

Vol. III, No. 1, p. 20, right-hand column, after line 31, *read* (Ushakov, *J. Russ. Phy. Chem. Soc.*, 1929, **61**, 795).

Page 19, left hand column, line 6, *for* System[1, 2] producing *read* System (I)[1, 2] producing.

Page 19, left hand column, footnotes *for* [6] Bühmann *read* [6] Billmann.

Pages 19 and 20, Formulæ I and VII

for *read* or

1350–34.—Printed at The Bangalore Press, Bangalore City, by T. Subramania Aiyar, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.

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